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Portals and Their Evolution

An Analysis of Portals With Communities of Practice

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Portals and Their Evolution

An Analysis of Portals With Communities of Practice

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Acknowledgements and Forward

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Forward

"Portals" of various types are a developing area of application and system software, and are continuing to mature. This report is a snapshot of Portals/Portlets as of February 28, 2004, and in some areas provides a short-term future view.

The report has brought to the attention of DRDC that the "Portal" concept is a complex scenario with the ability of an organisation to use Portals as an "Enterprise" tool, and within Portals use Portlets as an integrated team tool. This report provides an excellent spring-board to develop a Portal/Portlet system that will serve an organisation, which in addition to providing a sophisticated tool for internal and external collaboration, a Portal/Portlet system could bring significant efficiency to an organisation - for example by reducing the over-whelming daily influx of e-mails and providing a more integrated working environment to an organisation with remote locations.

It was hoped the report would provide a review of how collaborative software (CS) tools integrate in to Portals/Portlets. However, it is still early days in the Portal/Portlet market area, and in general (other than simple CS tools) these are not well integrated in to Portals/Portlets to date - with perhaps the exception of the most expensive Portals.

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Executive Summary

Abstract

Portals are frameworks for integrating all tools, applications, collaboration and information that is shared across an organization. This report discusses the current state of portals and models to analyze and understand which portals are most suited for specific business purposes. It also discusses a subset of portals called Community of Practice tools and provides an up to date analysis of these environments. Significant changes in portal software are taking place. This report provides a snapshot of the situation as of February 2004 and some view of the near term future.

Recommendations

DRDC DSTPol should use existing servers with existing Windows 2003 server software downloads to solve the problem of simple community of practice (CoP) support environments until the community becomes much larger.

DRDC should investigate portal technology with a detailed business case for the top four portals and decide after this point about implementation and deployment of general portal technology for all laboratories, client support, partner support and project support.

DRDC should track the rapid changes in portal development over the next 18 months with periodic updates each six months in order to keep DND/CF current with these changes.

Issues and Trends

Portal technologies are changing rapidly with the entire concept of a portal being redefined over the last few years. Today a portal is a software package which allows users to collect all applications and various web sites into a single unified package with common look and feel. It can be a common access point for all publics, stakeholders, customers, partners and employees to view, share and analyze information.

Various large vendors and a number of independent vendors also offer portal solutions. It is a competitive field with features and pricing changing rapidly and a shakeout of all but very established brand name companies. This segment is expected to see very rapid growth over the next two years as organizations move to integrate all their applications into a single common framework to facilitate knowledge creation, sharing and preservation and intellectual capital management.

Community of practice (CoP) tools are often perceived as portals but really are more specialized tools built specifically to support community development. (A CoP is a informal group working together which has a domain of expertise, a community and a body of knowledge that they maintain and grow over time.) The features of CoP tools are being provided by more generic collaboration tools and even placed in the operating system itself. This trend is eroding the benefits of specific community of practice tools, making them less attractive over time.

Tool Analysis

The tools were analyzed using four different models in this report. The first model describes how portals integrate the various components that organizations need into an overall framework which offers uniform look and feel. It also describes how portlets offer some integration but do not address deep information integration. (A portlet is a way to collect data from two or more separate applications and have this data analyzed and combined before being displayed, integrating outputs from separate applications.)

The second model shows how the different groups within an organization have different requirements for tools and how their tool needs will evolve over time. As portals are built, it is this model that will help determine the maximum value added in all the different tool environments and help practitioners decide which tools to add and to which groups to provide them.

The third model works with the second model and shows how all collaboration tools (unstructured data) can be segmented, positioned and evaluated for overlapping features. This tool is most useful for practitioners who want to eliminate overlapping features and move the organization as a whole onto a single integrated portal and toolset.

The forth model is used for analysis of communities of practice. It measures functionality well but the selection of specific tools is an art form because of specific organizational response to the user interface, the stage of community development, the group size, how often face to face meetings happen, community development processes and other factors.

Analysis Processes

The four models were applied to solve the specific problems of DRDC after the requirements were specified for DND/CF applications, DRDC portals and DRDC community of practice development. Recommendations were made from this analysis.

Results

The preferred CoP solution was Windows Sharepoint Services but a variety of other solutions would also do the job at low cost including: Community Zero, Intranets.com and BriteSuite, and Tomoye Simplify as a medium cost alternative.

The preferred portal solutions were: Sun ONE Portal, IBM WebSphere, BEA Application Suite and Microsoft Sharepoint. Many other offerings exist and would do the job but these were most suited given the requirements that were defined.

Portals and Their Evolution

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Table of Contents

Acknowledgements and Forward 2

Executive Summary 3

Introduction 9

Goal of The Report 10

Analysis Approach 10

Structure of the Report 11

Key Concepts and Models 12

Collaboration Concepts 12

Portal Frameworks 13

Portal Framework Overview 13

Presentation and Personalization Services 14

Taxonomy and Search Engine 14

Web Applications 15

Integrating The Portal 15

Structured Data Access 15

Unstructured Data Access 15

Portal Technologies 16

Portal Security 17

Portal Summary 17

Enterprise Tools Model 17

Collaboration Tools Taxonomy 24

Two New Views of Tool Environments 24

Group Size and Time Segmentation 24

Group Size and Functional Segmentation 25

Community of Practice Analysis Model 28

Requirements Analysis 31

DRDC/DND/CF Emerging Requirements and Systems 31

Operational Considerations 32

Routine Maintenance 32

Implementation Architecture and Languages 32

Thick client vs. Thin Client 32

Thin client .NET vs. Thin Client Java 33

Web Services or XML, SOAP, UDDI and WSDL Integration 33

DRDC/Canadian Forces Tool Requirements 34

Collaboration Tools 34

Other Portal Components 35

DRDC Tool Requirements 35

Goals and Objectives 35

DRDC 35

DST Policy 36

Community of Practice Requirements 36

Analysis 38

DRDC Large Portal Analysis 38

Concurrent Users And Total Users 39

Ease of Learning and Use 39

Storage Limitations 39

Processor and Memory Requirements 40
Legacy Application Integration 41
Access Speeds 41
Five Year Cost Estimates 42
General Summary 42
Total Cost – All DRDC Users 45
Total Cost – Limited Users 46
Recommendation – Larger Portal 46
Smaller Portal - Community of Practice Analysis 47
CoP Positioning Model Analysis 49
Cost Analysis 59
Recommendation - CoP 60
Bibliography 61
Books 61
Papers, Articles, Standards and Reports 61
Glossary of Terms and Acronyms 65

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Introduction

The internet view of portals has been changing rapidly. A few years ago a portal was a web site with rich content and services. Today, this is still true but the definition goes much beyond this for the organization. Part of the reason for this change is related to how our organizations are changing.

The emergence of a networked era has created a need to restructure and reorganize to create value in this new world. Knowledge in business is a key component of value creation in this new technological world [1, 5-8, 11-16, 35, 36, 103] [1] and portals are the key to creating new knowledge and preserving the existing knowledge within and across organizations. They tie together the entire organization with its partners, customers and employees to produce valuable new knowledge.

Organizations in this new technological world run completely on trust and without it they do not function because these organizations depend upon cooperation and knowledge sharing to create new knowledge and this does not happen without a high degree of trust. When trust is broken, communication is stymied and value creation is lost. Trust is the cornerstone of our new enterprises [16, 118].

A second key driver is specialization and focus on core competencies. By creating greater focus on core skills and outsourcing non-core skills, greater benefits can be produced for the organization. The outsourced workers now join an organization where they are part of the core services and value added increasing motivation and the delivered quality of services. This creates across the board efficiencies as long as the trust level is high.

For the enterprise, portals are integrated collaboration environments which should be the main place to share information and work together across the enterprise. If done properly, they can provide great savings and increased motivation and productivity for the organization.

Seen from a more technical point of view, portals are frameworks which integrate various tools and applications together in a common framework. By integrating all intranet and extranet access into a single unified site with a framework, development, maintenance, integration and ease of use all become substantially improved.

Ideally speaking, a single central place to look for everything is the best that you can do provided that the portal software performance is good. All information can be cross linked and stored once, updates can be assured and the intellectual capital of the organization protected. A portal like this can offer a complete environment for everyone in the organization to do their job, completely and seamlessly integrated with the desktop.

The overall benefits are:

- A single point of sharing and communication in the organization.
- Centralization of scanning and tracking functions.
- Simple enterprise level searching.

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[1] The numbers refer to the specific bibliographic references listed at the end of the report. The order of references is not important. A range of references are separated by a dash, (e.g. 7-10 means the range 7, 8, 9, and 10 inclusive).

- Elimination of duplicate information.
- Reduction in information overload.
- Improved communication with all partners and customers.
- Access to a consistent set of applications with support and backups.
- International and multi-site collaboration without difficulties of shared drives and similar issues.
- Simple cross-functional cross organization communication.
- Direct communication and consistent messages about the organizations norms and values – your hidden control system.
- Creating norms of information sharing and knowledge creation for the organization.
- Communicating new reward systems which emphasize knowledge sharing.

Portals are all about vision and organizational alignment with technology.
The technology is only 20% of the problem. The other 80% is making sure that the technology aligns with the business requirements and delivers true value to the enterprise. For this reason, we start with a vision and a business case to add value to the organization.

To make portals successful, there are twelve key things that must be done [1].

1. Organizational alignment must be priority one.
2. Barriers to success are business related. (Be very clear about the business case.)
3. Innovative rewards and recognition are vital to success too.
4. Cultural adaptation to use the portal is a key concern. Organizational change does not happen by chance: it must be supported.
5. New roles and responsibilities must be clearly defined.
6. Focus on user's needs – the key to success is understanding people's jobs at a very base level and giving them what they need to be successful.
7. Careful planning, implementation and support is required.
8. Creating high quality content so that people can rely upon the information in the portal is vital.
9. Information overload must be reduced and simple access to information is key.
10. Ease of use is essential.
11. Setting priorities on integration of components is important. Deliver value early.
12. Little high quality content is a clear means to improve use as opposed to a lot of useless content.

Goal of The Report

This report will analyze and summarize the changes in the portal world and recommend a portal strategy for DRDC, and support its Disruptive Technology Watch Community of Practice.

Analysis Approach

The approach taken was:

1. Define the key models and concepts.
2. Analyze the requirements.
3. Investigate the tools which are suitable to address the requirements.
    a. Discover which tools provide which features.
    b. Compare tool functionality.
    c. Within a given logical group of tools, look at security features, strengths and weaknesses, comparing the various tools.
4. Recommend particular tools which are most suited to the tasks at hand after more detailed analysis.
    a. Look at the environments in which the tools might run.
    b. Select tools most suitable for a given environment.
    c. Clarify additional steps required to deploy the tools.
    d. Select the four best tools and compare costs and performance.

Structure of the Report

The first part of the report provides details on the four models that will be used in the analysis and understanding of the various tools and requirements.

The first model shows how portals are put together as collections of portals, tools, connectors, legacy applications, collaboration tools and other components. It provides a framework to understand the various parts which could be integrated into a portal [1].

The second model is used for the analysis of toolset requirements. It explains what features are required by different groups within the corporation and how many different toolsets are required. This model can be used to understand overlapping tool requirements [32].

The third model is used to graphically represent the different features provided by specific tools and understand how the features from different tools combine to offer functionality to the users. It is best used in conjunction with the second model [33, 34].

The fourth model is used to analyze community of practice tools. It has significant limitations but is a brilliant approach for capturing the community tool functionality.

The integrated requirements for the various groups: DRDC/CF, DRDC and DST Policy are defined next. All have specific and unusual requirements of one type or another.

A decision was made to focus on two problems: the need for a portal for DRDC and the need to provide community of practice support for the DST Policy section. These two cases are considered separately.

The various leading solutions are analyzed using these models, knowing the requirements and estimating any costs associated with the implementation along with five years of support and maintenance.

Recommendations are drawn from this analysis.

All references are found in the bibliography and all acronyms are found in a table at the end of the report.

The terms of reference document is updated throughout this report, primarily in the section dealing with requirements.

Key Concepts and Models

Collaboration Concepts

For this report, a collaboration tool is defined as:

> A collaboration tool is a collection of computer software and supporting hardware which allows or supports the exchange, storage, sharing, display, creation or modification of voice, video, text, graphics, diagrams, photographs or other multimedia forms of communication.

Collaboration tools are by their very nature, communication tools. Those tools which promote the free and easy flow of information are thought superior from a collaboration point of view because they promote working together and sharing information.

Collaboration tools have been used for many years, starting with bulletin boards, news feeds and email. These early systems evolved in several ways to support a broad set of activities including the following.

- eLearning systems or systems that allow people to learn using a computer and networking to facilitate the training exercise. [45, 48, 42, 47]
- Synchronous Collaboration Systems that include instant messaging, video teleconferencing, video streaming and real-time collaboration tools. [4, 71, 78]
- Virtual Workspaces which allow users to share documents and information persistently. [65, 71, 38, 64]
- Distributed Project and Portfolio Management Systems which support project and resource management. [70, 44]
- Portals and Knowledge Management which allow organization or group wide information to be shared. [11, 12]
- Email and Workflow which support ubiquitous asynchronous communication and business process automation. [2, 15]

Traditionally, these different fields developed independently with different companies and groups providing various offerings with each field. Each product had unique features and products were differentiated on their feature sets. As tools evolved, the best features moved into all products and the various offerings began to merge into clearly defined functional groups.

In addition, the overall fields began to merge into one comprehensive product to better meet the needs of their user communities. A good example of this type of field merge is represented by the blending of eLearning systems to include both virtual real-time classrooms and asynchronous lessons and evaluation tools. Exactly the same has happened with virtual workspaces and synchronous collaboration systems – all leading products offer both feature sets because the combined features reflect the way that groups use the tools. This trend is expected to continue and eventually a few large vendors will dominate the upper end of tool offerings with fully featured collaboration platforms. [60, 61, 62, 69, 36]

Portal Frameworks

Portal Framework Overview

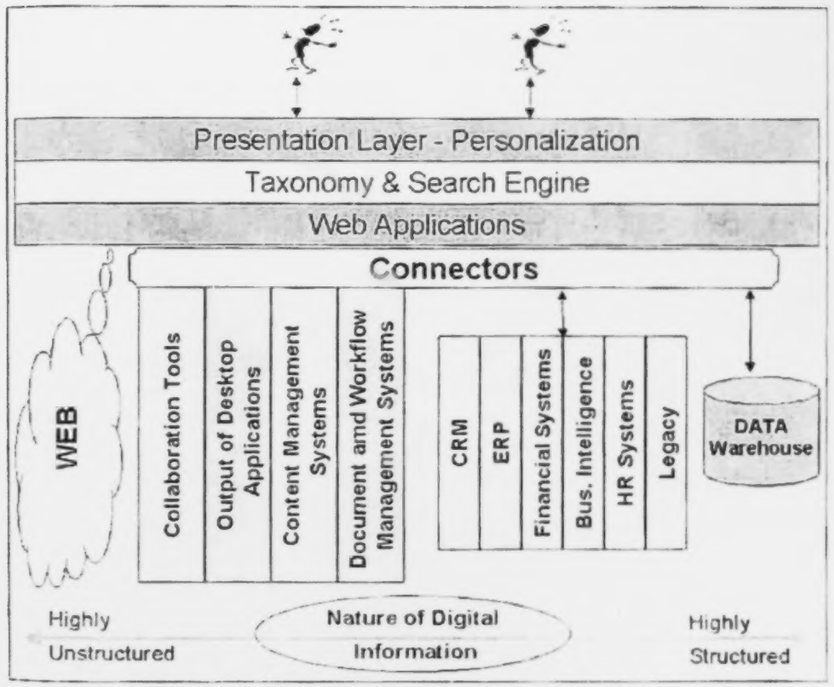


Figure 1, Portal Component Parts [1]

The diagram (figure 1) shows the various components which comprise a portal today. They all have a similar structure for the most part, with some minor exceptions.

Requests come from users across the internet, intranet or extranet and get filtered through successive layers of:

- Presentation and personalization,
- An information taxonomy and search engine which reaches all enterprise data,
- Web applications, and

- Connectors to a broad set of applications which deal with unstructured through structured data.

The unstructured data would be items such as collaboration tools and community tools and the very structured data would be information from internal data warehousing systems.

Using this type of framework, the portal can provide uniform and consistent access to a broad set of applications. All enterprise data is available and can be searched if connected to this system with appropriate connectors. All tools from functional groups and all tools from ad hoc groups are available to all, and all can participate in all the organizational communities.

Presentation and Personalization Services

These services define how users see and customize the portal to their specific needs. It is linked directly to the usability and therefore directly linked to the acceptance of the entire portal. The more intuitive, relevant and context sensitive this information is presented in the higher acceptance and productivity will be because it will make the user's jobs that much easier.

Taxonomy and Search Engine

This engine determines how easy it is to find the information for which you are looking within the portal and its associated information sources. The taxonomy is a key component because it allows browse type searching and categorizes information to limit the search. The taxonomy also supports an affinity type search – documents relevant to those who were looking at a document in this area. A good search engine will provide a broad set of searching approaches including:

- Keyword and exact phrases
- Boolean searches
- Bayesian inferencing based on the number of occurrences of keywords in the document
- Concept searches based on words which mean the same thing or are closely related.
- Context searches based on the context that the search takes place within to eliminate widely divergent data which has the same name (i.e. SAP).
- Natural language searches to simply specification of searches.
- Knowledge base searches that tap into previously asked questions which are similar.
- Popularity based searches which return the most popular referenced sites.
- Collaborative filters which will provide references which other users found most useful.
- Affinity searches which are like collaborative filters but use a broader set of criteria than just references.
- Visual mapping searches which allow users to see their results graphically to allow pattern sorting of data.
- Case-based reasoning searches (typical in service centres) which look for similar problems.
- Peer-to-Peer searches which search from a set of known buddy experts local contexts.
- Personalized agents which search based on the learning experience of the person and past search history.

The search engine will also provide notification services and search and retrieval for a broad set of information inside and outside the organization.

Web Applications

Most of these applications were developed to interface legacy applications to the web. Portals now provide sophisticated interfaces to map these legacy applications onto the web via the portal and make the integration appear seamless. An example of this type of integration is the new WSRP (web services for remote portals) and JSR (Java Specification Request) 168 standards.

These new specifications allow more seamless integration of services by ensuring that the different portlets are developed using an open technology base. The integration all occurs at the presentation layer on the web server as the user views the information. However, this is a poor place to integrate business logic (although some suites allow it) and without some integration the information extracted from different sources remains divergent.

Integrating The Portal

Structured Data Access

The goal behind integrating structured data sources into the portal is to make the data more accessible to everyone in the organization as the information becomes available (the real-time enterprise). Typical sources and applications are:

- Data warehouses
- Enterprise Resource Planning (ERP)
- Business intelligence
- Human Resources (HR)
- Customer Relationship Management (CRM)

This would involve extracting data in either a statistical form or a more raw form and presenting it to the user. Business intelligence is a good example of statistical information and CRM would generally involve specific customer data, although statistical account summaries could also be involved.

Ideally, the presentation of this information will be completely automated and customization will be allowed without intervention by the internal information technology systems and support department. Transformation of this information into XML and access via web services is becoming the norm to standardize access methods and ensure enterprise integration. These efforts support the core idea behind portals and knowledge management – that is the availability of data across the organization at all levels with distributed decision making will drive the organization to maximize its new knowledge production.

Unstructured Data Access

The integration of unstructured data and applications, ranges from document management and workflow through content management, desktop applications and into collaboration tools. Integrating these key applications allows users to work together across organizational boundaries and solve problems more effectively. These systems provide access to key shared information which can support group work, knowledge sharing and building on existing expertise.

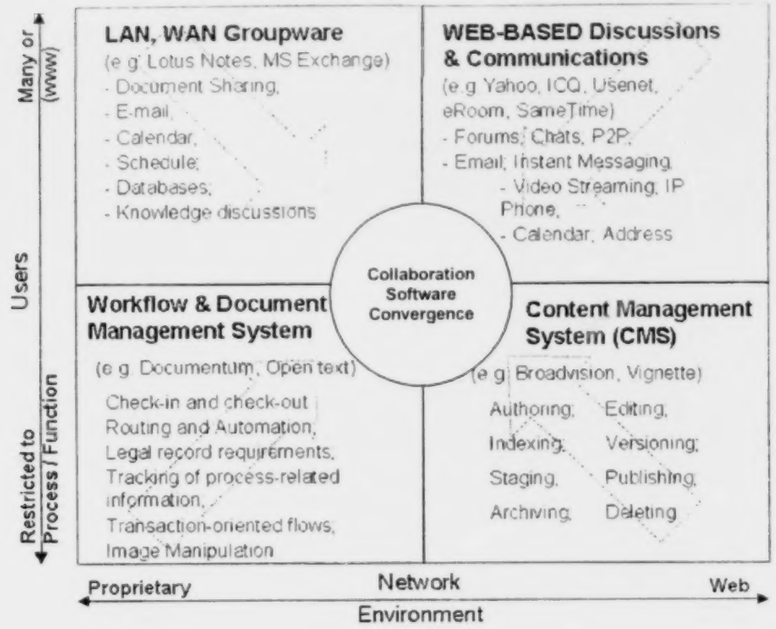


Figure 2, the convergence of collaboration software [1].

The link between these various tools is shown in figure 2 [1]. Content Management Systems support authoring and publishing of documents. Workflow and document management systems provide version control for documents and support processes within the enterprise. They are generally transaction oriented. LAN, WAN and Groupware tools provide scheduling, email, calendaring, document sharing, and knowledge discussions. Web based discussion tools provide forums, chat, real-time services, calendars, participant lists, project repositories and more. All four of these areas have been converging on a single integrated set of features called collaboration software or an integrated collaboration environment. This integrated collaboration environment is discussed in the context of a model to integrate these components in a later section.

Portal Technologies

There is really only two architecture technologies to choose from when developing portals, although some would contend that there is a third. The two approaches are J2EE and .Net. Both support all features required to build a portal and really differ only in minor ways.

There is a much broader selection of technology in the J2EE arena with almost all vendors supporting this approach compared to .Net offered only by Microsoft. There is also many lower cost tools in the J2EE environment with more open source tools. To move to J2EE and get the main advantages of the environment, sometimes the operating system should be something other than Windows for performance, security and reliability reasons.

This use of a different operating system is generally not a problem given that the portal is required to support a large number of users. In this case, a large data center with multiple large servers is a good choice for implementation. In this environment, web services will be used to integrate the various applications independent of operating system and environment approach.

Portal Security

.Net has some advantages in the security area and downloading of secure components but both are close to equal. Both solutions are migrating to WS-Security which is becoming an industry standard for web security.

J2EE supports liberty alliance while .Net supports MS Passport. It will be possible to integrate both solutions into a portal in the future so this is expected to make little difference. Liberty Alliance offers some improved distributed features that Passport does not have.

Portal Summary

Although all these various technologies offer different features, they are converging on a single integrated offering. The question remains: "How do we evolve our environment to support an integrated portal?" The answer lies in the specifics of the business case for your portal and the existing technologies in place within your organization.

The most important result must be alignment of business and technology solutions and value added for the business operation. With this focus it is possible to evolve from the existing situation to a more desirable set of conditions, but this set of decisions can only be made based on the specific conditions within the organization under study.

Enterprise Tools Model

It is important to remember that in the "Enterprise" model, the tools are designed to support an organization with individuals working within it [32]. This approach leads directly to a view of the firm or organization which has inputs and outputs within a nested set of environments as shown in figure 3.

Organizations and Their Publics

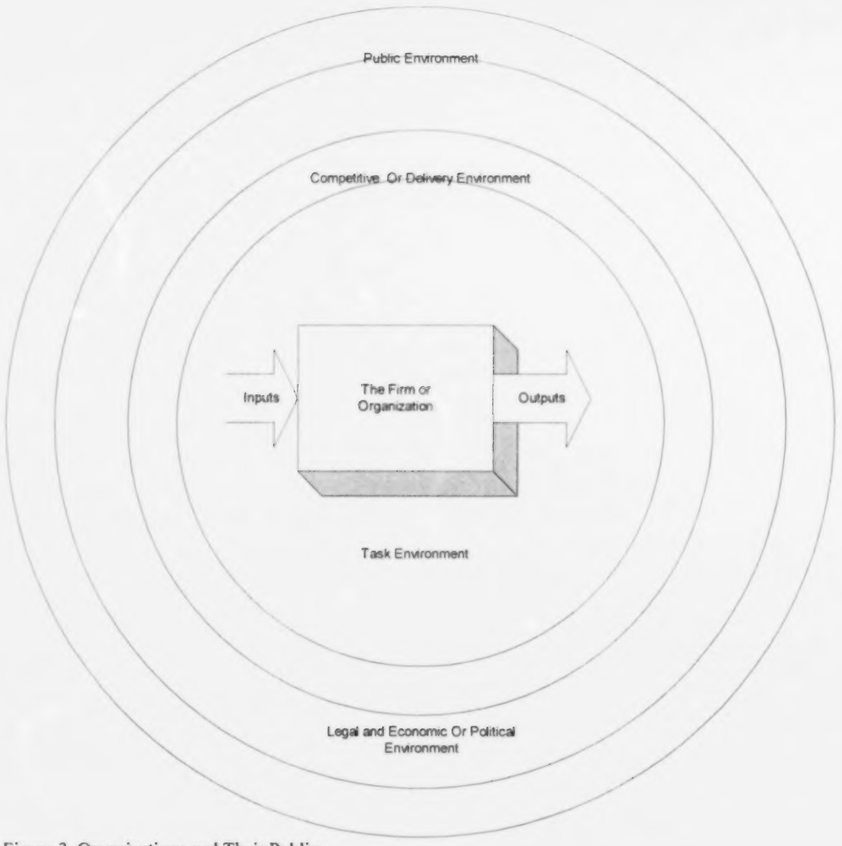


Figure 3, Organizations and Their Publics

The internal environment of an organization is implemented by a set of groups of dynamic composition working together. The various groups include the following:

- Staff groups
- Project groups
- CoP/eLearning groups

On the input side there are also groups which interact with the outside world for:

- Customer input and analysis
- Supply management
- General community input

- Competitive input

On the output side, different groups exist to satisfy the delivery of goods and services as well:

- Distributor and channel member groups
- Customer groups
- Prospect groups

Figure 4 illustrates these various groups supporting the efforts of the firm.

Organization or Firm

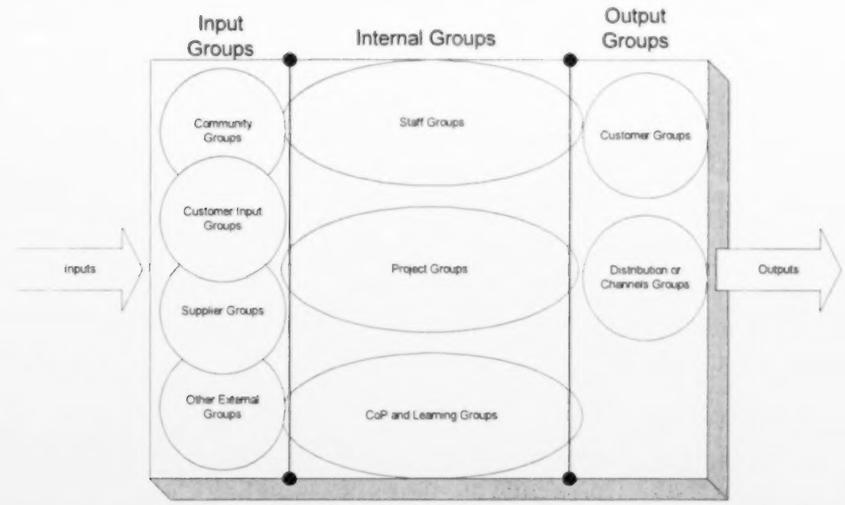


Figure 4, Groups And Locations Of Members Working Within Organizations

These groups all work together. Depending upon the area in question, they have various systems which tie together the work done in their groups including: ERP, workflow, and general communication systems. Each group, not just meta group type, will have a tool environment which is an integrated set of collaboration tools.

Today this environment might be crude, but in the future it will be more sophisticated. Enterprises will make great efforts to standardize these tool environments. This standardization will occur first within meta group types and then between the various meta groups.

The standardization between the meta groups will be done to achieve two goals. First, a common data set model could be used to underlie all the various groups making sharing of data much easier. Second, using a common data set opens the way for use of common user interface components so that the various tools in use and their look and feel can be standardized. The net result is that the environment will be integrated from both a data sharing and access point of view, and also from a user or use point of view.

Of course, this is an idealized approach. We are a very long way from having such an environment and one must question whether we ever will have this environment for a variety of reasons.

First consider a graph of the percentage functionality that a tool might offer versus the various meta group tools which exist for a firm at the input, internally and at the output. Figure 5 shows this graph.

Figure 5, Percentage Satisfied Versus Functionality Delivered

Now, each vertically focused tool has some functional offering which is from zero to 100% of the functionality required in a certain meta group area. Vertically focused tools will do very

well in their area and very poorly in other areas. An example of a vertically focused tool would be a CoP environment.

Horizontally focused tools will do poorer in a given vertical niche, but will offer much improved functionality in many more niches. eRoom, IWS, intranets.com, Groove and DCASoft Britesuite are examples of products fitting this horizontal model. Figure 6 illustrates how a vertical product might look and figure 7 illustrates how a horizontal product might look.

Figure 6, Functionally Vertical Solution

Percentage Satisfied vs Functionality For Horizontal Tool

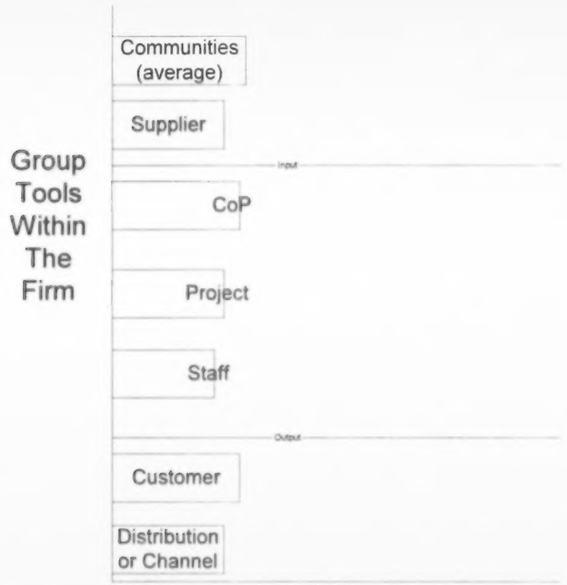


Figure 7, Horizontal Tool Solution

Another important factor in this equation is the 80/20 rule. Eighty percent of the work will get done using twenty percent of the functionality. As a result, the horizontal products appear to be very competitive with the vertical products in some markets. It is difficult to distinguish the advantages of the vertical products without very careful and detailed analysis of the both horizontal and vertical products for a particular application.

Ask, how can you get from where you are (many tools in vertical slices with many horizontal products but these products doing poorly in many areas) to one where you have a single horizontal tool in an organization, with specialized functionality built on top of this to serve each vertical meta group's requirements. The answer is that there is no foreseeable path

.

Individual niche tools will continue to outperform the horizontal tools and will always receive consideration for demanding applications in various niches. There are cases where vertical tools will be supplanted by horizontal tools, CoP tools for example stand a good chance of being eliminated as a vertical category, but there will always be some vertical tools in some niches.

No one company offers a completely horizontal product which has specialized functionality built on top of it to support a truly broad set of enterprise applications. Any companies that are touting the ability to deliver such a product are ignoring important market niches and requirements and really do not have a viable offering [32].

The environments which attempts to emulate a broad horizontal offering integrating a broad set of information into a single repository are portal frameworks. These frameworks, which integrate parts of the system from a user interface and search perspective do not provide deep integration of data, rather it is collected, processed and redisplayed at the user interface level. The technology which provides this superficial integration is based on new standards and the objects are called porlets. These solutions do not provide integrated data repositories but use the existing repositories and attempt to make them seem integrated to the user. It works well for simple applications.

Portal offerings come closest to delivering on this promise for simple applications but they have not addressed the issue of deep integration. Deep integration would allow any application to query, process and update any data in the system but portlets don't support this. Portlets, which are objects which collect data from various tools via the standard interfaces, process it and display integrated versions of the data. This is an excellent interim solution. Portals do offer content management integration and integration with email repositories, file systems and web pages, with search, personalization and the ability to integrate data at the screen via industry standard portlets.

The only companies which might offer a broad horizontal product in the future and have the market power to make it successful in the long term are IBM, Microsoft and maybe a combined effort from BEA and Sun. It is clear that any such product will illicit competitive responses from the other players, fragmenting the market. However, it would take an enormous effort to redevelop all applications to sit on top of a new framework, and there is not enough justification to make the development profitable. Historical approaches in other similar markets failed for these same reasons (i.e. Atherton Technologies in the software engineering database market). So if this is not the solution, what is?

Web services and portals which integrate disparate applications are the medium term answer. First, we know that there will be vertical tools – they offer advantages that will never disappear. These vertical tools will synchronize across tool groups to share data effectively – user interfaces and models of operation will be unique but likely XML based. Web services can serve as a platform to integrate these into the portal framework.

Using a portal solution, horizontal products with specific functionality built on top of them to support various niches have appeal in that they improve the data sharing model at a deeper level. User operation with the personalization from the portal solution will improve usability. These horizontal offerings will expand to deal with specific meta groups to completely satisfy a niche in the market. We can expect synchronization between these environments and the vertical tools as well as with other meta tool groups for deeper data integration of applications. We can expect synchronization between both groups of these tools and other framework tools which control what gets done including ERP, general communication tools and workflow tools. Clearly this is a hybrid environment and we can expect it to stay that way for a very long time.

It is within this environment that we must evaluate portal and Community of Practice (CoP) tools for the future.

Collaboration Tools Taxonomy

Two New Views of Tool Environments

There are many ways to segment the collaboration market into groups of tools. The approach described above, groups tools into meta groups based on user requirements. We will discuss the traditional means to segment these tools here and provide a new method of segmentation which is consistent with the meta tool group segmentation and portal analysis approaches [123].

The main approach used to date is to look at mapping the number of users against the amount of synchronous/asynchronous behavior. Using this approach , clear groups of tools emerge which can then be analyzed based on their features. This is the traditional way to look at tools like this and it will be called *Group size and Time Segmentation* for the purpose of this report.

Another approach is to consider the current integration of the tools. This eliminates the synchronous/asynchronous variable and leaves just the number of users to consider. Specific group sizes have unique requirements and tools generally support one or more group sizes. Within this context, specific group sizes have different tool choices which may be examined on a feature by feature basis for a given group size. For the purpose of this report, this is called *Group Size and Functional Segmentation.*

Group Size and Time Segmentation

The functional breakdown provided us with these basic tool types:

- eLearning systems or systems that allow people to learn using a computer, and networking to facilitate the training exercise in an asynchronous fashion.
- Virtual classroom or synchronous eLearning systems.
- Synchronous Collaboration Systems that include video teleconferencing and real-time collaboration tools.
- Asynchronous instant messaging systems.
- Synchronous streaming video systems (for large groups).
- Virtual Workspaces which allow users to share documents and information persistently.
- Distributed Project and Portfolio Management Systems which support project and resource management.
- Portals, Communities (including CoP) and Knowledge Management which allow enterprise or group wide information to be shared.
- Email and Workflow which support ubiquitous asynchronous communication and business process automation.

Each of these categories can be used to classify tools and then a feature based comparison can be used.

In addition, ease of use is an important criterion which is often not expressed in a feature based comparison.

Group Size and Functional Segmentation

Using a group size based approach; the following group sizes can be specified.

- Large communities
- Workgroups
- One or Two

Each group has categories which are based on secondary factors.

Large groups or communities can be disparate with few linking factors other than interest, or concentrated – all from one organization for example. Large groups or communities have functional categories of: eLearning systems, synchronous broadcast systems, portals and knowledge management systems.

Workgroups have categories for integrated virtual workspaces, synchronous collaboration, instant messaging, shared applications, streaming video, project management, email and workflow, eLearning, portals and knowledge management. The greater the integration between these components and the user's desktop, the more functional the environment becomes.

The "One or Two" users group has functional categories of: email, application sharing, virtual workspaces and instant messaging.

Using these groups and categories, a feature comparison of different tools can be completed. The following table shows a breakdown of the various features by group size. The rows have been positioned to indicate how different products generally block out "areas" of functionality which are connected in the table. The blue (or darkest areas if you have a photocopied version) highlighted areas illustrate where a group size and functionality or feature set intersect and create the greatest value.

The feature breakdowns used in this model are not cast in stone. In fact, it is expected that new breakdowns of feature sets will be made to better express the features across the entire collaboration environment. It is these features that will be mapped into the portal, and it is the overlapping features identified by this model that will be in conflict and will require some type of resolution. The model should also serve to indicate which tools require integration and do not have a linkage to support this integration.

	Single User	Two Users	Users > 2 & Users < 50	Users >=50 & Unified & Users < few hundred	Users >=50 & General & Users < few hundred	Users > few hundred
Collaborative Customer Relationship Management	Web site automated solutions	On-Line Sales and Support	On-Line Presentations			
Workflow and Process Automation			Simple workflow	Corporate Workflow Automation		
Email and Unified Messaging		One To One	Small Distribution	List Server	List Servers	List Servers
Instant Messaging		One To One	Small Group			
Virtual Workspaces		Often IM Connection	Typical Solutions Target	Sometimes		
Real-Time Collaboration		Often IM Connected	Meeting Automation	Large Meeting Automation		On-Line Streaming Video
Training On-Line	Users On-Line		Virtual Classrooms			
Training Content On-Line	Often	More Often	Larger Packages			
Knowledge Management			Group Knowledge Collection and Access	Corporate Knowledge and Communities of Practice		
Project or Portfolio Management			Group Management	Large Groups		
Portals				Unified Groups	General Groups	Very Large Groups
Communities				Communities	General Groups	Very Large

The different functional features are defined as follows:

Feature Name	Typical Feature Description
Collaborative Customer Relationship Management	Chat windows, audio and video connections, automatic escalation, help databases, information databases, sales process automation,
Workflow and Process Automation	Ability to specify the workflow, automatic email creation and addressing, may use roles and allow for temporary role replacements, auto approvals on message types, automatic alarms to correct level, may have supply chain capabilities
Email and Unified Messaging	Email, classified email capability, encrypted email, signed email, unified message queue from voice, email, SMS and fax
Instant Messaging	Instant message windows, buddy lists, groups, audio, video, file transfer, chat rooms
Virtual Workspaces	File sharing, document control, version control, threaded discussions, notes, shared calendars, chat (without full instant messenger), may have supply chain capabilities, management capabilities (members, permissions …),
Real-Time Collaboration	Audio, video, white board, chat (but not full instant messenger), room management, rooms, application sharing, automated invitations and authorization
Training On-Line	Content distribution, FAQ, Q&A, testing, result recording, retesting, virtual space and real time integration
Training Content On-Line	Content production capabilities
Knowledge Management	Community of practice support, collection, archival, search and retrieval, key word identification and management, threaded discussions, member management, authorization, events and calendars, It includes CoP
Project or Portfolio Management	Gantt and PERT charts, resource scheduling and leveling, multiple project integration, overall resource management and reporting, cost accounting
Portals	Information display, search, posting capabilities, management capabilities, tool integration, content management.
Communities On-Line	Search, posting, categories, information display, community news

Note that these categories can be refined within the same model and the model can be used for more detailed analysis of portals and community of practice tools. The definitions of segments are only included here for demonstration purposes. As the different tool meta types are integrated via a portal structure, it is this model that will indicate the different components and how they will overlap given different tool offerings.

Community of Practice Analysis Model

An analysis of portal related tools for communities of practice is a useful approach as it will deal directly with the features and requirements for optimal community development [33, 34]. The key assumptions of this analysis are that support is required across a large geographically distributed organization and that discussion of what a community of practice is and is not is not provided here. Please refer to the references for this information. Typical CoP facilities include:

- A home page which defines the domain of the community and provides navigation for the community subsections.
- On-line discussions
- A means to ask questions of the entire community or a subset of the community.
- Members directory with a definition of areas of expertise.
- A document repository with hierarchical storage to allow a taxonomy to be defined.
- A search engine with multiple search approaches.
- Community management tools.
- Support for subcommunities

And optionally

- Real-time instant messaging with audio and video
- eLearning support
- Synchronous meeting facilities with audio support and optional video.
- Synchronous presentation facilities with audio and optional video support.
- Community management tools supporting editors and subeditors for specific subject areas.

Further technical features should also include:

- Easy to learn, use and navigate.
- Easily integrated with other tools the community is using for their work.
- Sufficient security to meet the needs of the community.

A basic model to position products within this space is shown in figure 8 [33] Essentially the products are classified along four major axis.

1. Social structuring of knowledge: groups versus markets
2. The processes of sharing knowledge: interactions versus documents.
3. Context of learning: instruction versus joint projects.
4. The management of attention: synchronous versus asynchronous interaction

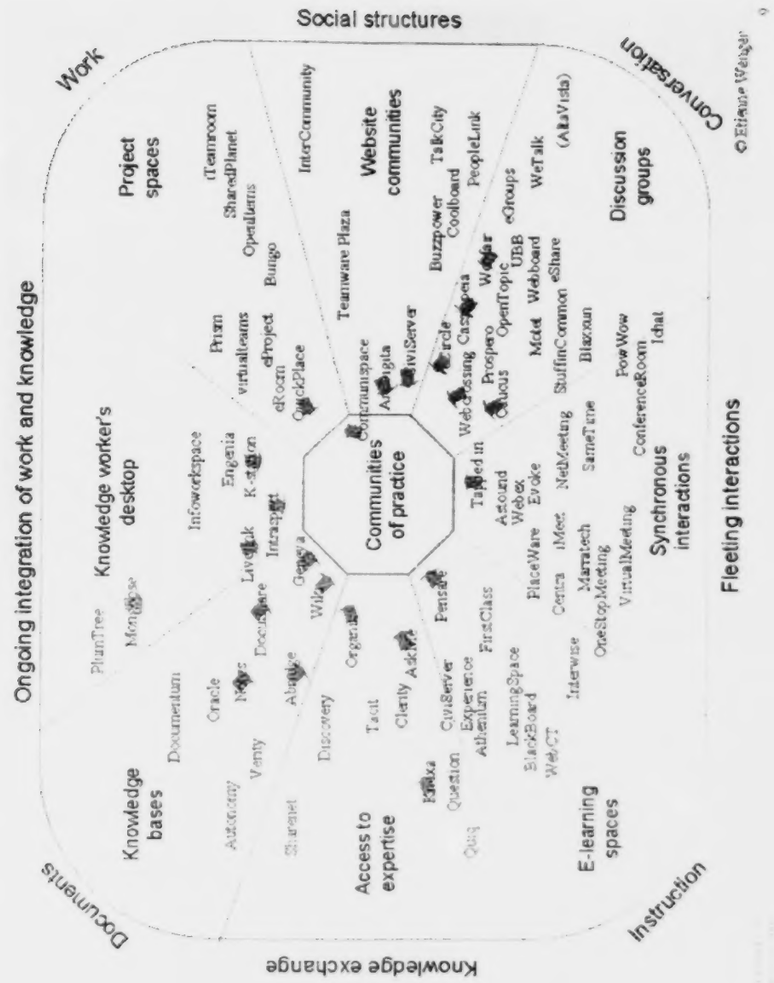


Figure 8: Positioning of CoP Tools - 2001

Rating a product in the space defined in figure 8 by placing it closer to the boundary of the space serves to separate products and define more clearly what there true offering is. This chart was made in 2001 but today it is not really possible to position products the same way. The axes are still correct, but the products have evolved to have features which cover multiple axes and now need to be graded along the eight dimensions. By connecting the values along the eight dimensions, a shape which characterizes the functionality of the tool along these eight dimensions is produced. An ideal tool from a functional analysis perspective would be described by a single dot in the centre of the diagram. Any environment which offers a solution inside the CoP circle is extremely functionally complete.

The ideal product is not ultimately defined as one offering the greatest functional coverage by having a single dot in the centre of the diagram even though this is desirable. As functionality increases so does complexity and adding these functions will tend to reduce usability so careful tradeoffs must be managed. The main selection of products which could meet the requirements of communities of practice as vertical products and selected horizontal offerings will be analyzed using this method..

Keep in mind that this approach measures functionality for CoPs. This model does not contain all information required to make a decision and needs to be used in conjunction with information about:

- Stage of development,
- Size of group,
- Existing equipment
- Budgets
- Usability
- Knowledge level of the group
- Anticipated evolution of the group.

The need for understanding these interdependencies and their relationship to other tools is broadly recognized [1, 5-8, 11-16, 33-37, 51, 79, 80, 83, 84, 88, 90, 93-100, 103-106].

Requirements Analysis

This analysis looks at DRDC/CF requirements and DRDC DSTPol requirements primarily. It also includes a look at DND/CF requirements because it is felt that DND/CF requirements will substantially influence how DRDC/CF work together in the future.

DRDC/DND/CF Emerging Requirements and Systems

The collaboration tool evolution is affecting the military, intelligence and security services in dramatic ways, in large part because the future engagements are expected to be smaller regional conflicts being addressed using multinational coalitions of forces. One of the main difficulties of coalitions is integrating diverse groups. This difficulty finds a practical solution in collaboration tools which integrate the groups over shared secure networks allowing them to work together to achieve their objectives. [17-29, 50-58]

The requirement for tracking and apprehending terrorists requires the cooperation of many diverse and geographically separated groups. An ideal solution for this problem is also a secure network and a collection of tools (which are potentially different) through which the participants can share data instantaneously, creating a much more responsive system. [49]

In both of these environments, the ideas of synchronous collaboration, persistent workspaces, portals, knowledge management, distributed project management, workflow, email, and eLearning are all required at various levels. In addition, both environments call for group sizes from one to a community of tens of thousands. [9-12, 37, 39-41, 43]

In the case of military systems, additional limitations are:

- Low bandwidth wireless links for field based units,
- Low processing power, limited memory wireless field units,
- Interoperability with other coalition military units,

These constraints are significant because field units are an integral part of any battle management system. These same units have low bandwidth links, limited memory and limited processing power. [28, 31]

To meet these diverse needs and integrate a collection of tools into a unified environment which can be accessible to all, DND will likely select a main portal environment at some future date. At present, this selection has not been made.

Operational Considerations

One key concern for any deployment of tools must be the operational cost of maintaining the systems over time and the operational approach to system maintenance. Prohibitive maintenance costs can dwarf initial system acquisition costs and hamper future efforts to modernize. This section discusses these operational concerns as they impact collaboration tool maintenance, deployment and security.

In the realm of secure collaboration environments, a few fundamentally different approaches have been taken to implement systems. Depending upon the approach taken, the maintenance of the system can change considerably. These issues are addressed under Implementation Architectures and Languages.

Routine Maintenance

Routine maintenance is the day to day work required to ensure that the system continues to operate correctly and to ensure that user problems get resolved. Regardless of the tool selected, it can be generally stated that someone must be responsible for maintaining workspaces and ensuring the environment is tidy. Without this type of support the environment degrades into chaos. This is no different from ensuring that your workstation and server workspaces remains tidy.

Adding and deleting users, recovering workspaces, changing permissions and similar tasks are all part of routine maintenance. Tools which support this range of features in a self serve user model will reduce costs considerably but these self serve features must be weighed against security checks and balances.

Implementation Architecture and Languages

Several choices exist for implementation architectures and different approaches create different medium and long term maintenance costs. The basic architectural considerations are:

1. Thick client vs. Thin Client
2. Thin client .NET vs. Thin Client Java
3. XML, SOAP, UDDI and WSDL Integration

Each will be considered in turn.

Thick client vs. Thin Client

Using a thick client architecture, users install various generic software packages, which are integrated into the portal, on an operating system and include an appropriate set of libraries or dynamically linked libraries. Over time, these libraries get updated and these updates can cause significant problems. Upgrades must be installed on each machine – an expensive exercise unless the entire machine is upgraded.

The main advantage of thick client solutions is the rich functionality that they provide on the desktop. Microsoft Word is a thick client in a client server architecture for collaboration today. The server, Sharepoint Team Services, provides document version control and sharing control. All of this happens within your current desktop environment.

On the other hand, the thin client model generally works much better in terms of maintenance. Many organizations have started standardizing on this model because of the reduced maintenance costs. This does not mean that thin clients don't sometimes need plug-ins or other components; they do. In the .NET thin client implementation, any missing components

are downloaded automatically in a secure framework. Most tools are constructed to work without the plug-ins with limited functionality, and plug-ins can be downloaded by prompting the user if missing or if upgrades are required.

In comparison, thin client solutions have generally been much less functional to date. In the future, the advent of web services and J2EE or .NET implementations will increase the functionality of thin clients considerably.

Thin client .NET vs. Thin Client Java

The Microsoft .NET approach (an extension of active server pages) uses several implementation languages including C/C++, C#, VB and others. In general, the implementation languages are intended to be VB and C#. .NET components are integrated into the browser environment and the ASP environment. Web services are used to provide linkage to other programs.

The second approach, taken by the rest of the industry, uses Java Version 2 Enterprise Edition (J2EE). The J2EE approach uses Java based web pages and Java servlets to provide N (multi-tier) tier support along with web services.

The main difference between these approaches is the vendor that you are choosing. In one case, Microsoft is the prime vendor and in the second case, a broad set of vendors support different components and tools in the environment. Sun does in fact still control the Java specification and this is a single vendor dependence.

As tools are chosen, the key question to ask is: "Am I comfortable with letting Microsoft solve my problems in the future or am I more comfortable with Sun's Java and multiple choices for vendors?"

Security associated with J2EE and .NET will be discussed later in this report.

Web Services or XML, SOAP, UDDI and WSDL Integration

The use of XML, SOAP, UDDI and WSDL protocols is a growing trend on the web and part of both .NET and J2EE solutions. Some portal development tools may not support them in the near term and this could be a substantially limiting factor.

XML is a very useful means to describe any document or data. It is also used in SOAP calls and other specifications. Currently, specifications are being upgraded to include encrypted data using standard tags and standard SOAP calls with certificates for authentication. This could form a basis for supporting multiple level security systems in the future.

There were two camps with respect to security for web services but they have converged into one. Sun, Microsoft and IBM have teamed to provide WS-Security, a collection of approximately seven standards. The Sun solution includes an end user authentication mechanism called Liberty and the Microsoft solution includes Passport. Time Warner's America On Line division also has an end user authentication solution with a large number of users which includes security provisions, presumably for web services and might also be a player.

In short, web services security will have multiple authentication means (Passport, Liberty Alliance and others) but it seems that standardization will prevail in the actual security architecture for web services. The three parties, Sun, IBM and Microsoft have agreed that the WS-Security specification being standardized by the Organization for the Advancement of Structured Information Standards (OASIS) will be used by them. Other higher level protocols

for security have yet to be defined by OASIS but it seems certain that all will cooperate to reach some acceptable standard to allow the market to develop more quickly.

Given widespread implementation of these standards, web security will become more ubiquitous. Of course, testing and evaluation will be required on the two underlying middleware approaches for the future: .NET and J2EE, but the security frameworks will be standard and both .NET and J2EE should be jointly deployable in the field in a secure manner.

DRDC/Canadian Forces Tool Requirements

Collaboration Tools

The collaboration tool analysis for DRDC and the Canadian Forces consisted of a series of interviews with the Canadian Forces Experimental Center and a review of available unclassified coalition forces information. At present, the Canadian forces are using some of the tools in battlefield simulations and are shaping their thoughts in the areas of project management, eLearning, and knowledge management. A broad set of literature was also reviewed to augment these discussions. [17-31, 47-77]

The results are as follows:

- Generally, a networked environment which supports all the standard office tools is required.
- Interoperability with DoD is an absolute requirement and is part of the DRDC/DND 2025 vision.
- An ability to share documents is key, and this is accomplished via email and virtual workspaces.
- Version control on the documents is a key feature to avoid errors.
- Threaded discussions are very important for battle management tasks because they offer 24/7 asynchronous conversations.
- Mapping capability is critical. Digital maps are shared as part of word documents and simply on their own.
- Tool integration is paramount to getting all the forces to cooperate in an action. This is currently not available.
- Video teleconferencing and real-time interaction is much less valuable than the virtual space tools on a day to day basis.
- Video conferencing is valuable, used periodically to keep everyone on the team.
- Instant messaging is valuable as the operation proceeds because it allows instant interaction without email overheads.
- Digital Dashboard and associated features of DCTS 1.0 were less useful than the Groove approach.
- Groove Networks type functionality was substantially better than other approaches because of the ease of use that it offered in a single package.
- The red line features of Word were very useful in sharing and editing documents.
- Wireless support will be good down the road, but is not a hard requirement today.
- Meetings need automation. They are taking over at exercises and something is needed to minimize the overhead.
- Mission planning could really use workflow tool assistance.
- Multiple secure levels or tagging of data with enforcement of some kind with interoperability over secure networks seems to be a good solution.

- Bandwidth must be used intelligently by all these tools. It can make a huge difference with many users during an operation.
- Wireless solutions with mobile base stations bring another level of complexity not being considered here.
- eLearning could really benefit DRDC/CF/DND in a large way.
    - SCORM support for standard modules.
    - Elimination of redundant training.
    - Train in transit to the theater of operations.
    - Rapid generation of new courses and integrated course programs is essential to support specific missions.

One unaddressed area which is key, is communications. Collaboration type tools must consider voice over internet protocols (VoIP) technologies integrated into this mix. In addition, seamless messaging for email, voice, fax and all other events should be managed in a single queue (unified messaging). These types of features are also critical for quality battlefield management.

Other Portal Components

The range of other portal components required for DRDC/CF are as broad as the specification of the various areas of tools which might be included with the exception of CRM. In general, CRM is replaced by help desk type applications as they really don't have customers.

ERP, Business intelligence, legacy systems, data warehouses, and much more are all considered as part of this mix.

DRDC Tool Requirements

Goals and Objectives

DRDC

- Engage clients
- Engage partners
- Engage allies including: DoD, MoD, RAN, …
- Develop a worldwide reputation for excellence.
- Provide a platform for scientists to collaborate on across the country.
- Provide a collaboration environment for clients, partners and allies to work together.

To accomplish these goals, a portal allowing DRDC to connect both internally and externally with various partners, and customers would be extremely useful. It would provide the ability to integrate various laboratories with headquarters, provide uniform storage and document access, integrate project and program management systems, collaborate with allies, and extend its influence with customers, allies and partners.

This integrated portal would be good for productivity across DRDC allowing everyone to share a common vision and tools, irrespective of geographic location. Using an approach which exploits the hidden value of shared vision would be a very effective means to improve moral and increase productivity, particularly in remote locations

Customers and partners would change their view of DRDC as a result of a high quality portal strategy. At present, ad hoc collaboration occurs on a broad set of research issues. This approach would provide a single unified message and vision to all the different groups that used to portal and give DRDC the ability to sell the vision and a broader range of services to the extended community. A portal, used like this, becomes a key marketing tool, creating new business opportunities with these same allies and partners. This would be a key benefit of a portal solution.

Integrating legacy systems is a key portal feature and something that could be easily accomplished. Presently, headquarters systems and lab systems for project tracking and program tracking are not generally synchronized. This causes difficulties and friction within the organization and wastes valuable time for senior scientists. The portal could integrate these systems and solve these problems.

DST Policy

- Engage scientists and DND in discussion about the future requirements of CF.
- Introduce disruptive technologies years earlier in the development cycle to accelerate the benefits to the CF.
- Accelerate the pace of innovation for the CF.

Community of Practice Requirements

The current Disruptive Technology Watch Working Group (DTWWG) operated by DST Policy section consists of a group of CF and DRDC practitioners which are all interested in advancing the practice of introducing technology into the CF. They are all interested in accelerating the adoption of new knowledge, practices and equipment.

DTWWG is in fact a community of practice associated with disruptive technologies. They work together to further the practice of introducing new technology. The CF members provide information on technology requirements while the DRDC people provide information on scientific details and analysis of various alternatives.

Members in this group are in all DRDC laboratories and DND/CF facilities across the country. For this reason, the community must have on-line support to avoid costly travel and to keep everyone in the loop between meetings.

This on-line support tool must include all the basic features of a CoP for scientific research including:

- A taxonomy to organize information so it can be easily found,
- Document storage,
- Search capabilities which include files, email, discussions and the web,
- Expert listings and contact information,

- Threaded discussion,
- A home page which conveys the vision,
- Events and announcements,
- Self governance including polling or voting
- Security provisions with roles and approvals.

The community needs flexibility to attack the current problems of the day and to develop some type of solution that delivers real value to the CF. For this reason they are self governing, and work on a volunteer basis. Members help each other solve the complex technology problems of the day working only on those problems that they deem important to their jobs.

To keep all community members in the loop, synchronous support tools are required along with asynchronous tools. These can be used as follows:

- Ask the expert with real-time audio and video support.
- Webinars with expert guest speakers.
- Information meeting places on the Internet to allow people to build their network and stay in touch with remote members of the community.

These tools, used in this way will allow members to develop greater social affiliations with the group providing a broad set of benefits into the future.

These community of practice tools will be backup up by face to face meetings including:

- An annual Science and Technology Symposium for all practitioners,
- Quarterly face to face meetings, generally held in Ottawa.

It is felt that these face to face meetings are required to build the team and common vision, and to deal with high priority issues.

Many references have been used to develop and refine the list of requirements as well as estimate the future requirements for the DTWWG [5-16, 33-37, 79, 80, 88, 90, 93, 94, 96, 97, 99, 103].

Analysis

From the requirements, a literature review and from the models presented, it is clear that there is two separate scenarios discussed here.

1. DRDC Portal Requirements
2. DST Policy CoP Requirements

For the purposes of clarity, the discussion will be separated into two parts: a discussion of a portal for DRDC and a discussion of a CoP solution. Furthermore, the DRDC portal requirements will be broken down further into a getting started solution and a full blown solution for all of DRDC.

DRDC Large Portal Analysis

To analyze portals for DRDC, the key criteria are:

1. Number of concurrent users – 100.
2. Total number of users – 1000.
3. Ease of learning and use.
4. Storage limitations
5. Processor and memory requirements.
6. Estimated costs of acquisition, implementation and support for five years.
    a. Hardware acquisition and maintenance costs.
    b. Software acquisition and maintenance costs.
    c. Application development and integration costs.
    d. Application maintenance costs.
7. Compatibility with existing equipment and reuse of existing systems.
8. Ability to integrate legacy systems.
9. Fast and reliable access for all partners.

Concurrent Users And Total Users

In general, there is no limitations to adding users to the system other than how it might effect licensing costs and hardware requirements. The actual concern and requirement here should be response time because a slow portal is not used and some alternative is created. The goal for a comprehensive large portal solution should be to allow all DRDC employees to be connected at all times during the working day and have access by an additional 100 partners and DND/CF personnel. In this case, the response time to load a new page should be less than five seconds for simple pages and twelve seconds for very complex pages with data included, for all users.

The only way to find the system response time is literally to go out and measure it in the conditions that apply at the site which is accessing the information. For this reason, this evaluation criteria is really pretty nebulous unless pre-selection we are prepared to go and measure all systems in a specific test environment. Our solution to this problem was to rely upon performance measurements made by independent third parties.

Ease of Learning and Use

Based on the experience with various prototype portal software, a key criteria is ease of learning and use. Although some people did not have difficulty with the system, many others found the idea of a taxonomy which linked discussions to the specific content quite difficult to navigate. A better organizational approach was deemed to be centralization of the discussion items so that there was one place to go to see everything that had been discussed. In a small CoP environment, spreading out discussion items is clearly a problem. In a very large CoP environment, centralizing discussions is a less functional approach and a subscription based notification system is a better choice to ensure that people receive timely updates.

In the case portals, ease of learning and use is a critical function. If this is not the case, the portal will simply not be used, or will be used with problems from all sides. In this case, some analysis shows that sometimes it is better to pay more for portal development and ensure that the ease of use is present than to use more automated approaches which will decrease the development cost. This may in fact have some validity, but in general, automated approaches will save substantial amounts of time and money during development and maintenance. This tradeoff must be very carefully considered since intangible future benefits might be generated or not and very real expenses are being incurred to purchase these intangibles.

By evaluating user interfaces on existing implementations and looking at references, it is possible to get a good feel for the ease of learning and use. This is the approach that was taken here.

In general, all portals evaluated in detail provided good usability. It was not a major differentiator for the most part except for some specific areas of strength that some vendors had (i.e. Sun One portal in directories of people). In any case, there was no strong compelling reason to give one vendor a big advantage over another.

Storage Limitations

For all practical purposes, there are not expected to be any storage limitations for these portals as they are all relying upon underlying SQL database servers which are tried and proven in the field using terabytes of data.

Processor and Memory Requirements

The actual processor and memory requirements are of considerable interest because it can have a huge impact on the overall system cost for the enterprise. Traditionally, enterprise systems have been implemented with mainframe and mid-frame servers but today, the costs of implementation with multiple smaller servers is becoming acceptable. This change is occurring for several reasons:

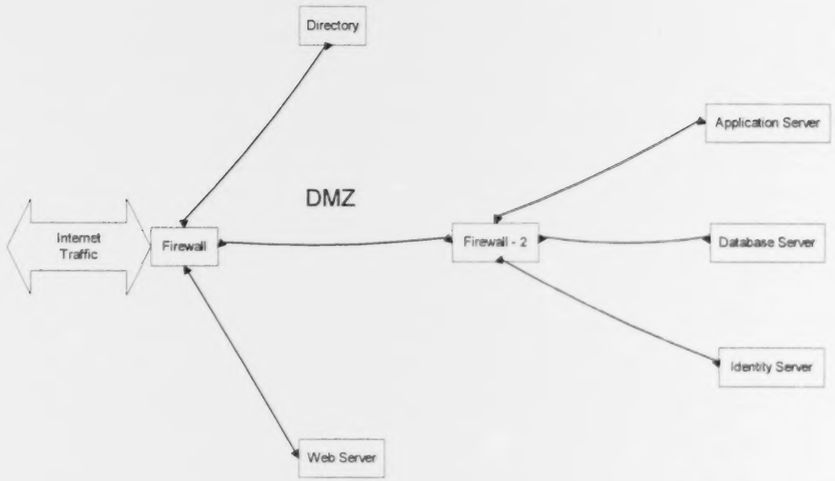
- Reduced cost of very fast Intel/AMD processors.
- Low cost hardware production from volume sales.
- High quality multiprocessor Windows operating systems,
- Technologies to serve identical pages with multiple servers, offering dynamic load balancing while the database runs on another fast multiprocessor server provides truly great performance at low cost,
- Diminished differences between IBM/Sun/Unix performance and Intel/Microsoft solutions.

Given this set of conditions, the Intel/Microsoft solution with multiple parallel servers might be favored, but actual costs must be measured over five years to get a true picture. Existing Sun equipment could offer great performance for many years at reasonable costs without major changes or disruption and this must be considered in the cost analysis for a final system but will not be considered here. In addition the rapid lowering of Sun equipment costs based on 64 bit architectures is changing this landscape quickly.

This analysis will assume a standard layered architecture for security purposes. The architecture depicted will need five high performance four processor machines and two, two processor machines. It should be capable of serving 100 users. The choice of J2EE or .Net will make no difference. It assumes that the certificate authority (CA) for certificate management is found on a completely different system and that a shadow directory server is not required. Software licensees for this architecture will be estimated in the final costing numbers.

The cost of firewall software is included in this estimate. It is assumed that two different firewall solutions will be used and that they are not remotely programmable. The cost of local dynamic tape backup is included in the backend of this system complete with autoloader capabilities. This will maintain high security.

System Architecture - Portal Solution



Legacy Application Integration

All portal solutions from leading vendors support key standards like WS-Security, XML, UDDI and SOAP which are generally lumped into a single description of web services. By using this integration approach, great flexibility will be created for future systems definition.

Access Speeds

The access speed has been an issue for participants working with DRDC portals from home or DND/CF people working through the firewall. Changes to the firewall rules can easily bring the system grinding to a halt. Often trouble occurs from one building to another.

The answer is to give direct access where possible. This means that all internal DRDC people would have direct access and not have to contend with firewalls. If bandwidth requirements are too great, these can be increased to deal with this problem. For people from DND/CF and partners, there is no answer for this problem other than to deal with performance issues on a case by case basis. They will all have to come in over the internet.

For this reason, the portal should be hosted at DRDC so at least all DRDC staff get good performance independent of security firewall decisions..

Five Year Cost Estimates

General Summary

The main assumptions that are driving this estimate are:

- A basic portal framework with all execution engines (application servers) and a database solution are assumed.
- Feature sets include basic content management, discussion groups, searching, user lists, management console and taxonomy specification but exclude most other features unless they come bundled with the base portal.
- A framework development suite is included but it does not include the price of a development environment unless it is bundled with the development suite libraries.
- Minimal hardware is assumed given that DRDC seems to have all the necessary hardware to run a basic system today. This includes Sun systems and Windows based solutions with sufficient processing power to support a base group of users.
- Running an enterprise portal solution on the Sun servers is also considered along with alternatives of running the entire DRDC enterprise on Intel/Windows servers. This was included because it is a likely scenario under consideration at DRDC. The cost of working on Sun servers or Intel based servers is approximately the same for high performance machines.

The portals that were considered include the following offerings:

- BEA [98, 110]
- Microsoft Sharepoint [81, 85, 101, 119, 120, 121]
- IBM Websphere [108]
- Plum Tree [107]
- Computer Associates [115, 116]
- Vingette [86, 92, 105, 106, 113, 114]
- Oracle [102]
- Sun One Portal [111]

The analysis did consider a few others but in depth investigation was not undertaken on these offerings. They included:

- Sybase
- SAP
- Peoplesoft

- Novell
- Broadvision.

The final five were chosen as:

- BEA
- Microsoft Sharepoint
- IBM Websphere
- Plum Tree
- Sun One Portal

This selection was made on the following basis:

- The latest versions of the software were compared – this moved the evaluation onto the latest version of Sharepoint and Oracle 10i.
- Performance was a consideration.
- Survivability in the market was a factor, although the leading independent vendors (BEA and Plumtree) were both included because of their cost structures.
- Considerations were made for the development environment and development cost.
- The development cost on the latest version of Sharepoint software was unknown and was assumed to be identical to development costs associated with J2EE environments. No data was available on the validity of this assumption but given general competitive evaluations in the market, it seems reasonable.
- Where volume licensing costs were unknown, an estimate of 2/3 of the cost of a single version was made. This is the general industry rule for these costs.
- The number of Sharepoint users was assumed to be 500 in the smaller case and 2000 in the larger one.
- The Sun licensing of $157/user for all portal related software was used. This includes a complete development environment for all DRDC employees based on Sun and allows unlimited external users.

No special consideration was made for the available hardware and how it might effect the overall cost or cost reduction of the system. Available Sun hardware was not considered but replacement hardware at the cost of Winidows/Intel was assumed. .

Overall, BEA Systems offered the most compelling offering for a portal coupled to a development environment for a low end system. It could also run on the Sun hardware which is available. BEA could run on any platform. Note that this is based on the values provided by "independent" evaluators with respect to the development cost of developing on the BEA

toolkit as opposed to other toolkits and it does not include any evaluation of how usable these solutions are compared to other solutions other than those generally available in others work.

The BEA offering was most attractive largely because of the low cost of acquisition and the low cost of development created by the web methods toolkit. As maintenance costs are considered, the overall cost of the development and maintenance of the portal is dramatically less than competing solutions.

Microsoft Sharepoint is a compelling technical solution and its familiarity for DRDC/CF people is a major plus. Furthermore, its integration with Windows Sharepoint Services makes an even more compelling story. It is the number two solution, and some pricing breaks by Microsoft and more accurate development cost estimates could easily make it the most effective solution overall.

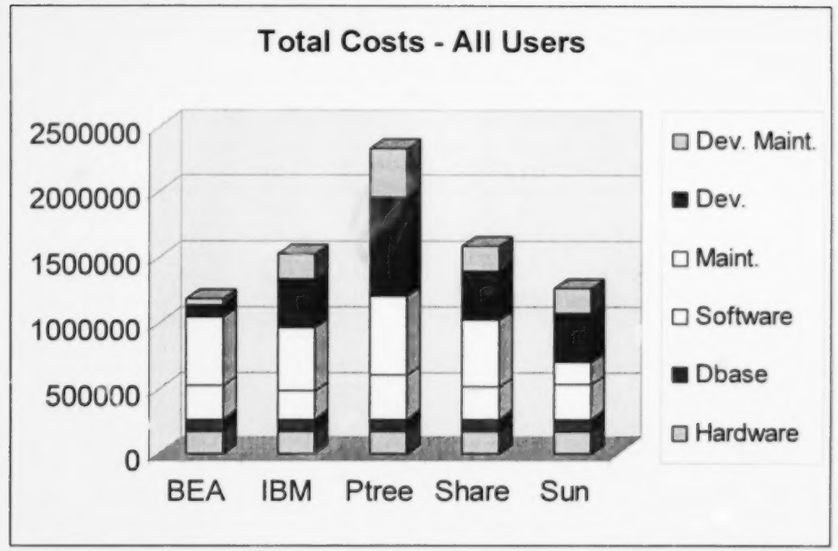
The Plum Tree solution suffers from high development costs. Some argue that these are off-set by improved user satisfaction, but given that the cost of maintenances is also high as a result, this approach should likely be avoided because the other solutions which offer lower cost programmability will improve their usability with time.

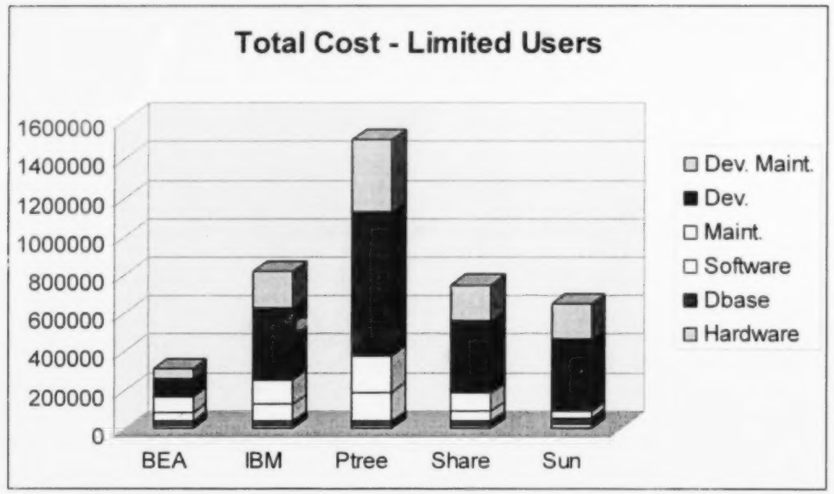
The IBM solution is competitive but because of its higher development costs offers an inferior solution to that offered by BEA.

Also of note is the Sun One Portal Server. It is highly regarded in general. **The combination of the Sun portal with the BEA development environment could be an excellent solution** as well because BEA offers lower development costs with a cursory glance.

The performance, size and development cost estimates were made based on median industry costs, development cost estimates and reasonable assumptions about development costs based on API standards, and direct comparisons of products by independent groups [95, 109, 113, 117, 122]

Total Cost – All DRDC Users





Recommendation – Larger Portal

The results of this analysis are incomplete. They show that the BEA solution is quite competitive and offers lower risk in an incremental approach due to its lower development costs. The combination of the Sun and BEA solutions requires more careful thought as it could be the most compelling solution. Microsoft Sharepoint also offers what is needed and really great comparisons of development costs are not readily available which could make all the difference.

The next step in the analysis would be to do a detailed analysis of the costing of each solution with the specific business case in mind along with a detailed analysis of the features offered by the solutions in question. Estimation of development costs are critical in this decision so this would have to be done based on very specific DRDC requirements for the portal. This analysis could be confined to the following list: BEA, Sun and Microsoft. IBM could also be considered. Expect prices to vary dramatically as real opportunities are presented to the vendors.

Smaller Portal - Community of Practice Analysis

Like the more general portal solution, the community of practice solution must meet the basic needs of the community. In general the key issues apart from CoP support features are:

1. Number of concurrent users – 100.
2. Total number of users – 1000.
3. Ease of learning and use.
4. Storage limitations
5. Processor and memory requirements.
6. Estimated costs of acquisition, implementation and support for five years.
7. Compatibility with existing equipment.
8. Security
9. Bilingual capabilities

The CoP support requirements are listed above and here are just summarized in tabular format for each of the vertical solutions. Horizontal solutions also have a summary here and the rapid convergence of the industry is apparent.

Limitations with respect to the number of users, number of concurrent users, storage space, processors and memory requirements were met by all the systems in question.

Description	Tomoye[2]	Communispace[3]	iCohere[4]	Community Zero[5]	Intranets[6]	Windows Sharepoint Services[7]	DCASoft[8] Britesuite
Taxonomy	Y	Y	Y	Y	Y	Y	Y
Documents	Y	Y	Y	Y	Y	Y	Y
Search[9]	Local	Local	Local	Local	Local	Local, Y with additional products	Local
Experts	Y	Y	Y	Y	N	N	N
Discussions	Y	Y	Y	Y	Y	Y	Y
Home	Y	Y	Y	Y	Y	Y	Y
Events, Notification	Y	Y	Y	Y	N	Y	Y
Governance And Polls	N	Y	Y	Y	Y	Y	Y
Security	Limited	ASP provided	Limited	Y	ASP provided, fair	Y	Limited
IM with Audio/Video	N	N	N	N	N	Separate Product	N

[2] [87], hands on evaluation, prototype, extensive discussion with developers
[3] [91], discussion with developers
[4] [82], discussion with architects
[5] evaluation and demonstration, discussion with developers
[6] hands on evaluation, discussion with developers
[7] hands on evaluation, discussion with architects
[8] hands on evaluation, discussion with architects
[9] The search feature response of Local is given if simple included documents are searched along with discussions and other direct input. A Y rating is given when external search support of web sites databases and more is provided.

Meetings with Audio/Video	N	N	N	N	N	Separate Product	N
Webinars with Audio	N	N	N	N	N	Separate Product	Y
Virtual Meeting Place	N	Limited	N	N	N	N	N
Integration of Additional Tools	N	N	N	Y	N	Y	Minimal Dev. Rqd.
Scalability, Multiple Communities	N	Y	Y	Y	Y	Y	N
Bilingual	Y[10]	N	N	Y[11]	N	Y[12]	N[13]

CoP Positioning Model Analysis

Using the model presented above, the tools can each be graphed along the eight axis and a representation made of the nature of the tool for CoP work. Versions with and without add on products from the same company are presented.

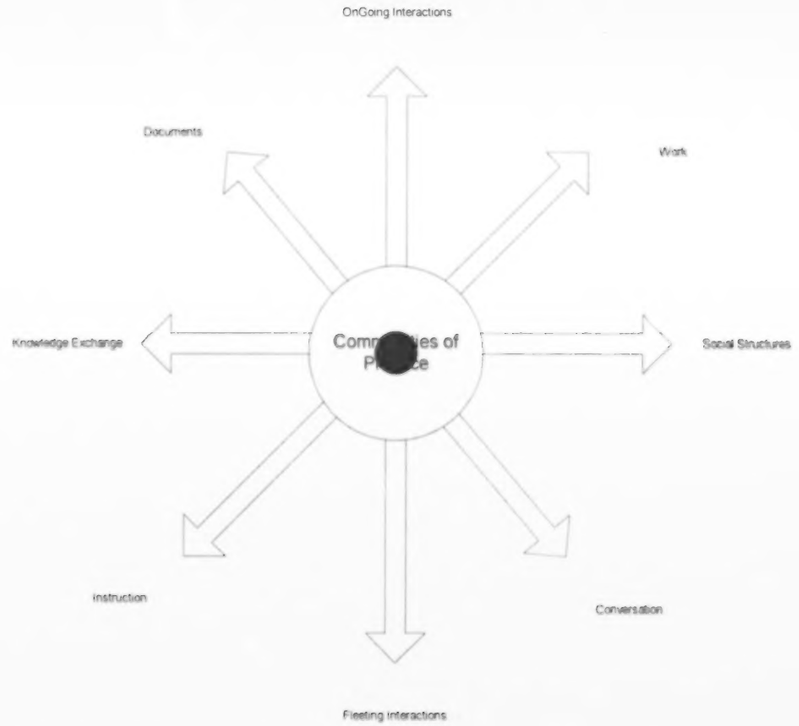
For each of the variables the relative strength of the product on that variable to support CoP activities was estimated. All distances and measures are relative.

An ideal solution would have a shape within the CoP boundary as well as having all the non-functional specifications like usability highly satisfied as shown in the following diagram.

[10] Excluding the help system, a serious limitation.
[11] Community Zero bilingual versions will be available April 1, 2004.
[12] Windows Sharepoint Services is currently available as a download. Full language versions of Windows Server 2003 will be available shortly which will offer a French version.
[13] Source code licensing allows all strings to be changed if desired.

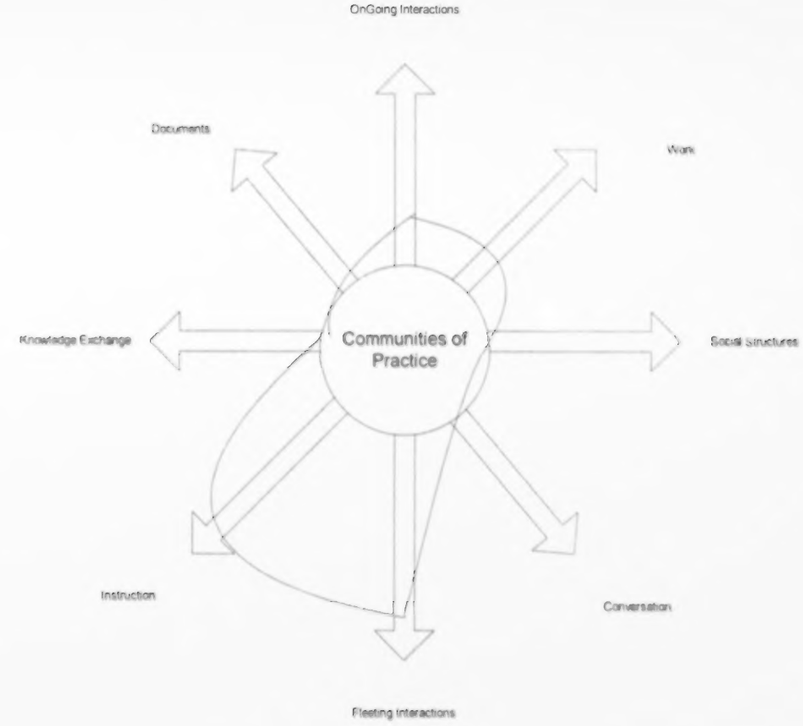
CoP Tool Positioning

Ideal Solution



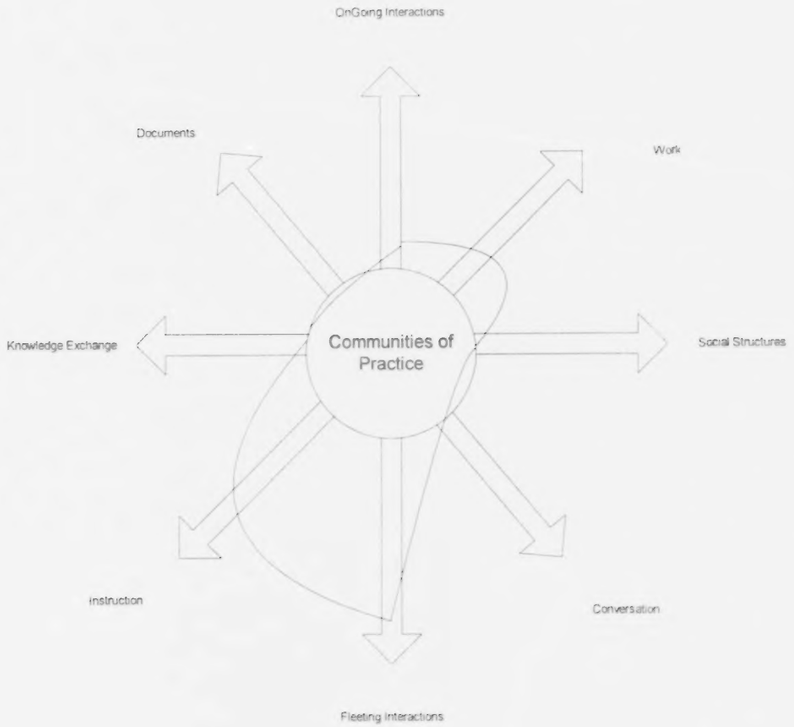
CoP Tool Positioning

Tomoye



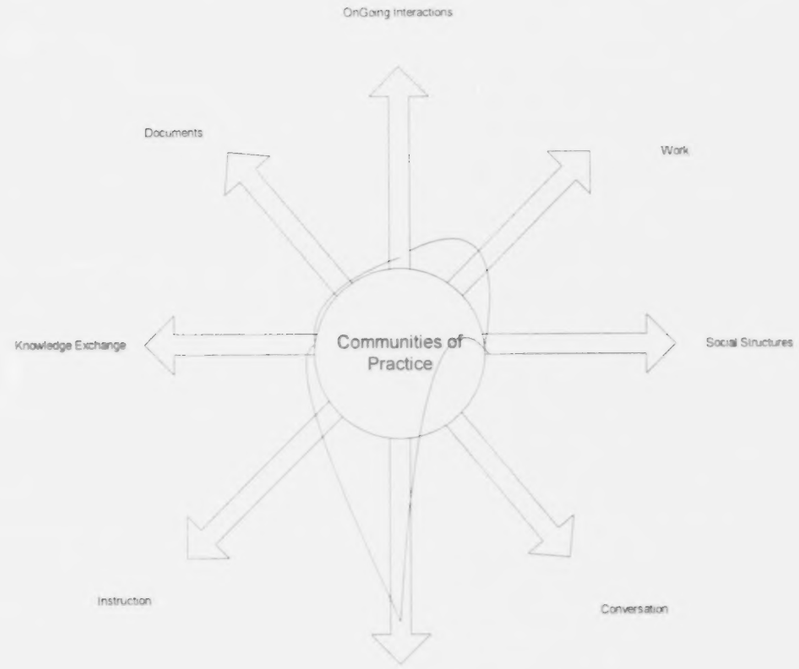
CoP Tool Positioning

Communispace



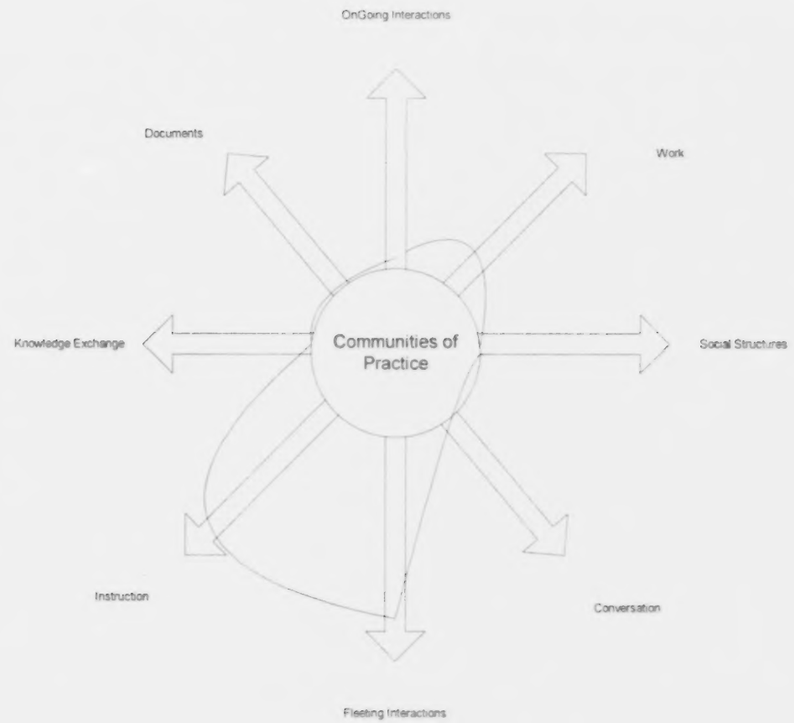
CoP Tool Positioning

iCohere



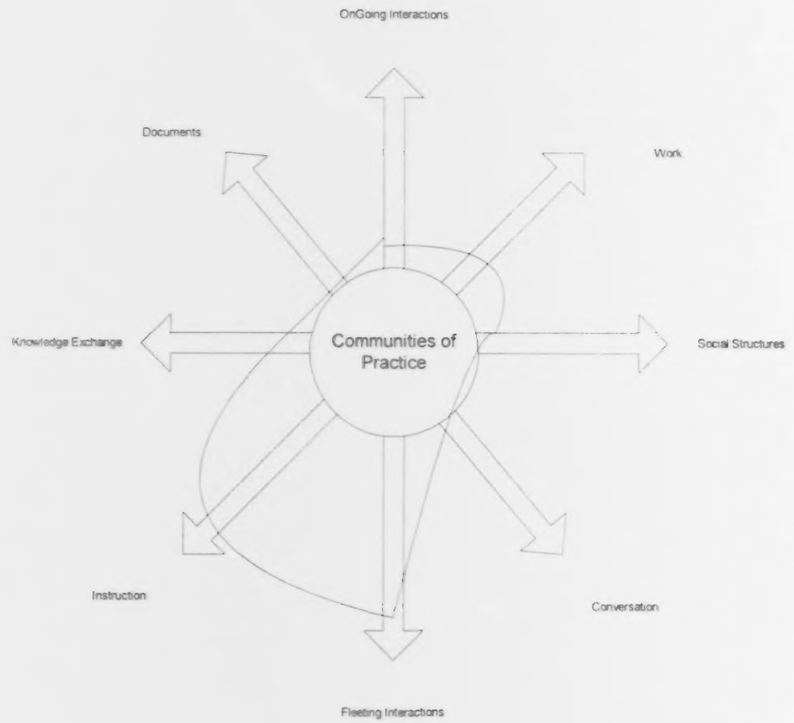
CoP Tool Positioning

Community Zero



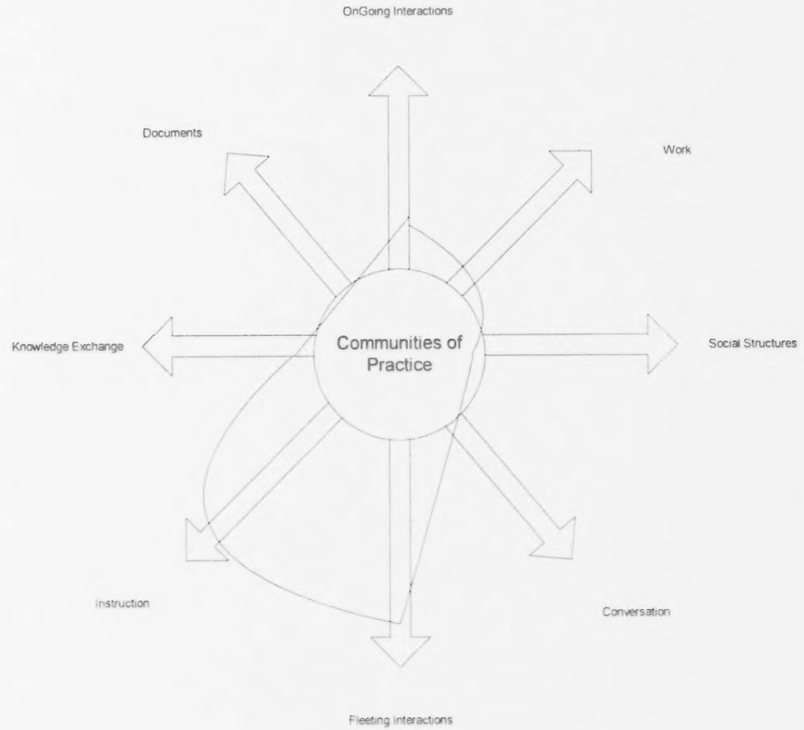
CoP Tool Positioning

Intranets.com



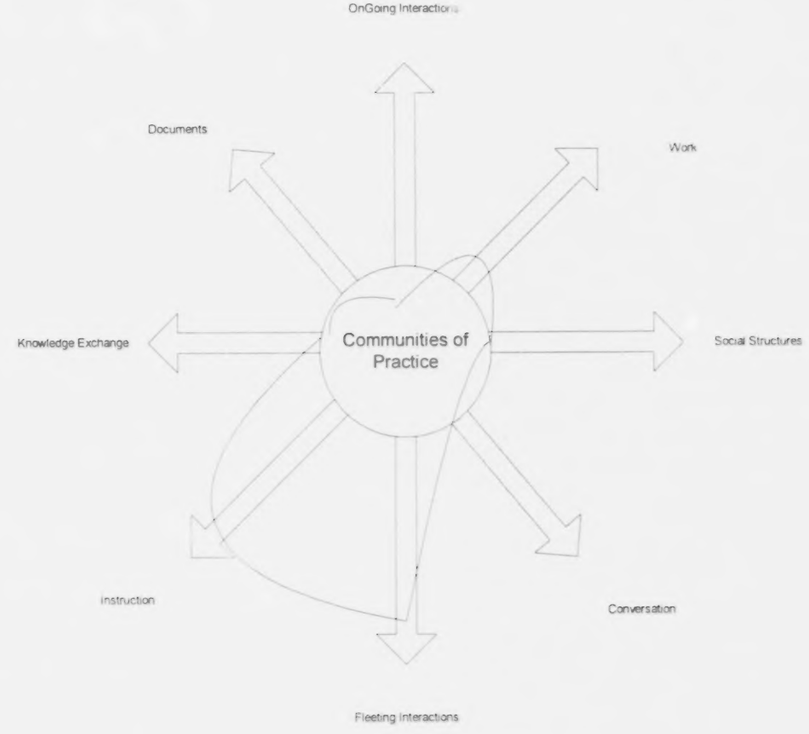
CoP Tool Positioning

Windows Sharepoint Services



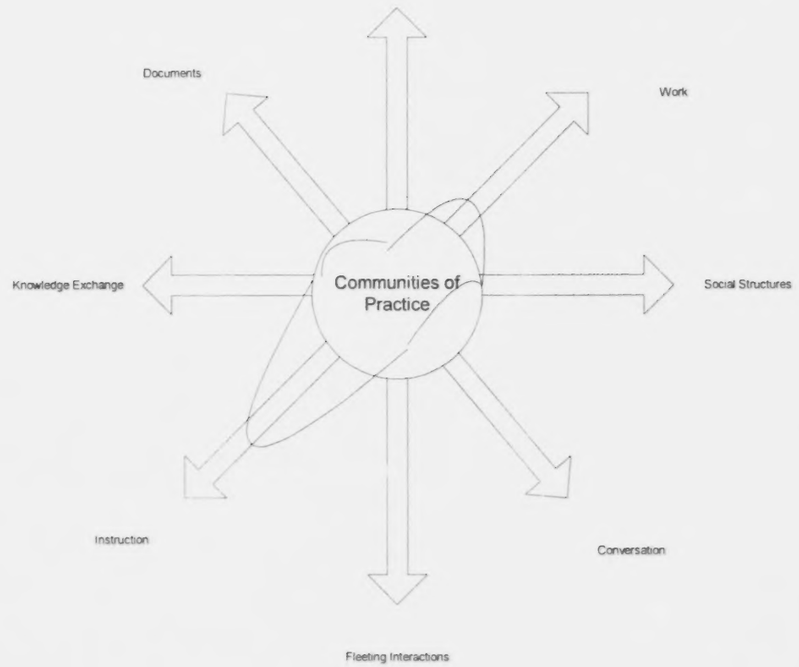
CoP Tool Positioning

Windows with Sharepoint Portal



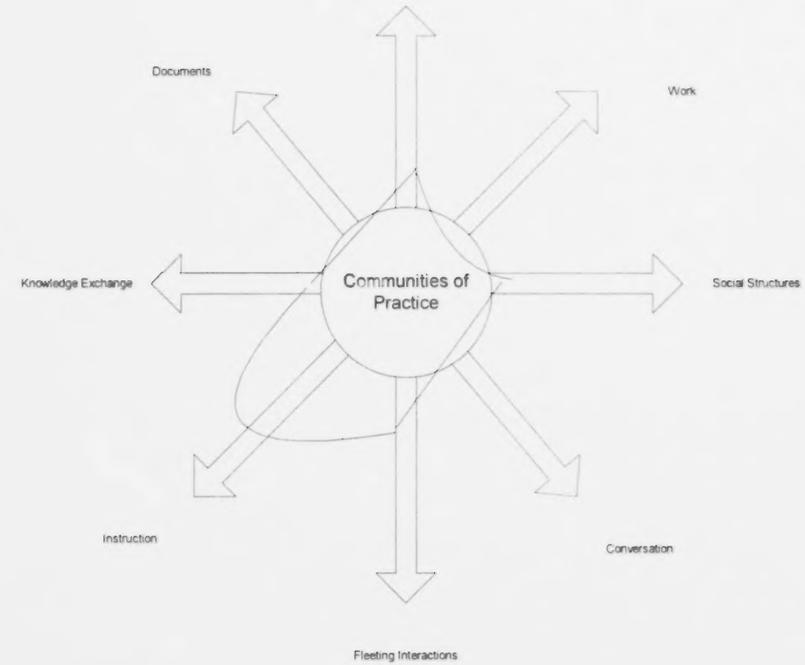
CoP Tool Positioning

Windows with Sharepoint, Live Meeting
MSM



CoP Tool Positioning

BriteSuite - DCASoft



Cost Analysis

The above analysis indicates that the Microsoft offering is as strong as any with a few exceptions and it is completely free. Existing DRDC hardware can be used and the software is free on the Windows 2003 Server platform which DRDC has just upgraded to. There is no additional maintenance costs of any kind. In addition, it is very usable and compares to the

other simpler solutions that were evaluated for community development including intranets.com, Tomoye[14] and Community Zero.

All other solutions cost something, from a few dollars per month per user to tens of thousands of dollars for server licenses. For example, Community Zero costs are approximately $75/month/community which is very inexpensive. The intranets.com solution costs approximately $10/user/month for our user group size. The BriteSuite product costs $999 USD (or $1250 CDN) for a single community but with unlimited users. It has a much more complete project environment. All of these are reasonable alternatives. However, there is no reason to spend any money – you can get all functionality required for the near and medium term for nothing by simply using the free download from Microsoft.

Recommendation - CoP

The Microsoft Sharepoint Services for Windows 2003 Server should be used for community development. It can be done at no cost other than setup. Users from DND will be intimately familiar with the solution and those from DRDC will learn easily.

With this recommendation must go the comment that the analysis provided is far from perfect. The model used needs to reflect a greater understanding of the issues that really matter during community startup and operation and it does not do this fully. The model needs to consider other factors more fully like: functionality required by development stage, functionality required by community size, development processes, and usability.

In the absence of a comprehensive model, this is more of an art than a science and it would be equally easy to use different criteria to justify another solution. The choice here was based on equal functionality, excellent usability and zero cost without risk.

[14] Tomoye costs $50000, a more medium cost price.

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Glossary of Terms and Acronyms

Key Word	Description
.NET	A distributed programming environment for both web and thick client operation introduced in 2002 by Microsoft.
API	Applications Programming Interface
Asynchronous Collaboration	Collaboration, which occurs over time through the exchange of information (e.g. email or threaded discussions).
Audit	Reviewing information to assure that the information conforms to expected norms.
Authentication	This is who an entity is or an association of an identity with an entity.
Authorization	This is what the entity is allowed to see and do.
Bandwidth	In this context it is interpreted to mean data rate or bits per second although it is not an absolutely correct use of the term.
Caveat	A warning that is appended to a category which provides a warning and creates another compartment (e.g. CAN Eyes Only, NOFORN) with special handling.
Client Server	A client server architecture involves a server computer which does processing of requests for many users typically, and a client program running on another computer or computers across the network making requests of the server.
CMS	Content Management System
Collaborative Customer Relationship Management	Chat windows, audio and video connections, automatic escalation, help databases, information databases, sales process automation,
Common Criteria	This is the standardization of the systems level testing and certification for all five eyes countries for security products. It is called NIAP in the US. Different levels of standardization exist within the standard.
Communities On-Line Definition	Search, posting, categories, information display, community news
DCTS	Defense Collaboration Tool Suite
Digital Dashboard	A technology for group portals integrated with Microsoft Outlook which was developed by Microsoft.
DISA	A component of DoD Defense Information Systems Agency which is responsible for standardization of information systems among other things.
Distributed Project Management	Distributed project management is identical to portfolio management.
DMZ	Demilitarized Zone or the zone between a front end firewall and a second firewall.
DND	Department of National Defence
DoD	Department of Defense in the US.
eLearning tool	A collaboration tool which supports delivery and preparation of a course over the Internet. It might be either a Content Management System (CMS) or a Learning Management System (LMS).
Email	A messaging system which allows users to exchange text, graphics, files and web links. Users send messages expecting some delay before a response is received.

Email and Unified Messaging Definition	Email, classified email capability, encrypted email, signed email, unified message queue from voice, email, SMS and fax
eRoom	A virtual workspace tool offered by Documentum (and formerly offered by eRoom).
Firewall	A collection of software and hardware which only allows specific network requests through to the far side of the firewall. Typically calls are filtered on packet state, addresses and ports.
H.32X, H.323, H.320	H.32X refers to both H.323 and H.320. These protocols are the IETF standards by which video conferencing is done. H.323 is Internet based while H.320 is based on PSTN ISDN connections
Instant Messaging Definition	Instant message windows, buddy lists, groups, audio, video, file transfer, chat rooms
Instant Messenger	A messaging system which allows users to exchange small text messages, graphics, files and web links in a single window – waiting for the other to respond.
Integrity	When referring to data, ensuring that the data has not been modified as is done with a digital signature.
Internet Protocol Security	IPSec is the main protocol which augments IPv4 to build virtual private network tunnels through the network.
IPSec	Internet Protocol Security
ISDN	Integrated Services Digital Network
J2EE	Java Version 2 Enterprise Edition, a distributed programming environment to support web based applications developed by Sun Microsystems (now Sun ONE) and supported by IBM and others
Java	A programming language.
Java Applet	A small program which is automatically downloaded onto your computer when you browse a web page and an applet is included with the page.
Knowledge Management	The management of the ability of people to act effectively. Generally this involves both process – Communities of Practice, capture of knowledge or learning, conversion of knowledge into information (or information/knowledge extraction and storage), retrieval of information/knowledge and dissemination of information and knowledge. (Dawson, Wenger et al)
Knowledge Management Definition	Community of practice support, collection, archival, search and retrieval, key word identification and management, threaded discussions, member management, authorization, events and calendars
Lattice Model	A classification scheme for information which involves a hierarchy of levels with increasingly greater need for security (e.g. unclassified, confidential, secret, top secret) and codewords to break them into groups (e.g. Crypto, Foreign, …). These segments are called categories or compartments. Categories are extended with Caveats and International Defense Organization (IDO) designations. Descriptors or descriptive words may be added but these do not affect handling.
Liberty Alliance	A group formed by Sun to promote Sun's view of security for web services single sign on. This technology competes with Microsoft Passport.
LMS	Learning Management System used to manage multiple courses and results.
Multiple Level Security	This is support for lattice model type separation of information in a computing environment.
NAT	Network Address Translation is address translation by routers to allow reuse of IP addresses to build a separately addressed internal network.. It causes problems in H.323 environments in particular.

P2P	Peer to Peer
Pass Phrase	A phrase or collection of words used in place of a password.
Passport	A technology developed by Microsoft to allow single sign on to multiple web sites once the user is initially logged on.
PKI	Public Key Infrastructure
PMI	Privilege Management Infrastructure or a means of centrally managing authorization of users to certain critical and protected resources.
Portal	A web site which provides information to a group of interested parties and may involve user interaction, news items, and pertinent shared real-time information.
Portals Definition	Information display, search, posting capabilities, management capabilities
Portfolio Management	In the context of collaboration tools, portfolio management means integrating the results of managing various projects throughout the organization to look at the results for the entire entity under consideration.
Privilege Management Infrastructure	A means of centrally managing authorization of users to certain critical and protected resources.
Project or Portfolio Management Definition	Gantt and PERT charts, resource scheduling and leveling, multiple project integration, overall resource management and reporting, cost accounting
Proxy Server	A server which sits behind a firewall and calls out on behalf of other clients that are unable to call out themselves.
PSTN	Public Switched Telephone Network
Real-Time Collaboration Definition	Audio, video, white board, chat (but not full instant messenger), room management, rooms, application sharing, automated invitations and authorization
Reverse Proxy Server	A server which sits in the DMZ and relays requests to the backend service environment behind a second firewall.
RSVP	Resource Reservation Protocol is an IETF protocol for reserving bandwidth (and thus buffers) for an RTP connection.
RTP	Real-Time Transport Protocol used by H.323. allows statistical feedback from endpoints to monitor quality of service and adjust transmission to meet service needs.
SCORM	Shareable Content Object Reference Model Initiative, a standard for representing course information. Pre 2001 this was called "Shareable Courseware Object Reference Model Initiative.". SCORM consists of three main sections: an Extensible Markup Language (XML)-based specification for representing course structures (so courses can be moved from one server/LMS to another); a set of specifications relating to the run-time environment, including an API, content-to-LMS data model, and a content launch specification; and a specification for creating meta-data records for courses, content, and raw media elements.
SOAP	Simple Object Access Protocol, used to access backend services using HTTP and port 80 with XML encoded messages.
Social Engineering	Attempts to penetrate a security system by attacking the people and their willingness to help others. This can involve "accidental" meeting outside the office or impersonation by phone or in person in the office.
SRTP	Secure Real-Time Transport Protocol is a new standard supporting a secure transmission layer within the Real-Time Transport Protocol to support encryption and decryption.

SSL/TLS	Secure Sockets Layer, and the standardized version, Transport Layer Security
Strategy 2020/2025	DND approach to forces modernization until the year 2020 and 2025 respectively.
Synchronous Collaboration	Collaboration which occurs at the same time by all involved parties (e.g. a face to face meeting or an electronic meeting on the Internet with live bidirectional audio and video.)
TCO	Total Cost of Ownership
Thick Client	A client side program which requires installation on the computer to become functional. This may involve a browser being updated by a plug in which must be installed
Thin Client	A client side program which does not requires installation on the computer to become functional. This may involve a browser being updated by a java applet which is automatically downloaded and installed.
Total Cost of Ownership	The actual cost of having a software application installed, running and maintained over time.
Training Content On-Line Definition	Content production capabilities
Training On-Line Definition	Content distribution, FAQ, Q&A, testing, result recording, retesting, virtual space and real time integration
UDDI	Universal Description Discovery and Integration is a means to describe services and make specific calls to discover what services are available.
Unified Messaging	A system which puts all voice, email, fax and wireless SMS messages in one queue for central access, typically with a automated voice response system for remote telephone retrieval, or an application integrated with email client.
Video Conferencing	Technology which allows both voice and video to be shared by all participants. It generally also includes: chat windows, white boards and shared applications.
Video Teleconferencing	This is the same thing as video conferencing.
Virtual Classroom	An environment which provides real-time audio, video and other tools so that students can participate in a classroom setting electronically.
Virtual Communities	Virtual communities are communities of people with like interests in some area that interact using some collaboration tool on a network.
Virtual Workspace	A collaboration tool which supports document sharing, multiple users, groups, shared calendars, notes, threaded discussions and more.
Virtual Workspace Definition	File sharing, document control, version control, threaded discussions, notes, shared calendars, chat (without full instant messenger), may have supply chain capabilities, management capabilities (members, permissions …),
Virus	A computer virus is a computer program usually hidden within another seemingly innocuous program that produces copies of itself and inserts them into other programs and that usually performs a malicious action (as destroying data)
VoIP	Voice over Internet Protocols, a new standard for voice transmission over the Internet based on H.323 among other protocols.
Web Services	The collection of XML, SOAP, UDDI and WSDL are now collectively called web services and they are the backend service that Internet based applications call to get processing done. Web services are supported by both .NET and J2EE.
Wi-Fi	This is a wireless network "slang" term for the IEEE 802.11b standard.

Workflow	The flow of goods and information from person to person in an organization, where each party adds to content to complete organizational tasks.
Workflow and Process Automation Definition	Ability to specify the workflow, automatic email creation and addressing, may use roles and allow for temporary role replacements, auto approvals on message types, automatic alarms to correct level, may have supply chain capabilities
WSDL	Web services description language supports the description of a web service which is then discovered using UDDI. It is a language that defines a contract between the client and the server so that services are clearly defined.
WS-Security	A set of specifications which support web services security being promoted by IBM and Microsoft. Sun has recently agreed to support these standards too.
XML	eXtensible Markup Language, a variant of SGML which allows user defined tags overcoming the major short comings of HTML

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14. ABSTRACT

(U) Portals are frameworks for integrating all tools, applications, collaboration and information that is shared across an organization. This report discusses the current state of portals and models to analyze and understand which portals are most suited for specific business purposes. It also discusses a subset of portals called Community of Practice tools and provides an up to date analysis of these environments. Significant changes in portal software are taking place. This report provides a snapshot of the situation as of February 2004 and some view of the near term future.

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15. KEYWORDS, DESCRIPTORS or IDENTIFIERS

(U) Portals; Computer programs; Collaborative software; Community of Practice; Knowledge management; Comparison; Integrated systems; Information systems